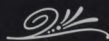# MOMENTUM

COLUMBUS STATE UNIVERSITY
An undergraduate research journal for the 21st century.

Vision Statement

Momentum advocates the presence of a diverse student population conducting independent studies. It serves as a platform to promote creativity inquiry and intellectual critique among undergraduates from all disciplines. Led by an Editorial Advisory Board, the biannual journal conforms to the highest levels of academic honor by utilizing a blind review process that permits erudite submission from undergraduates across all disciplines. The journal's ultimate goal is to publish works of scholarly research among a wide range of captivating themes. Momentum accepts perspectives, quantitative and qualitative research and creative inquiries from undergraduates in the Columbus State University Community.

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Letter from the Provost

Dear Reader:

Please allow me to congratulate the editorial staff of *Momentum*, Columbus State University's undergraduate research journal. Editor-in-Chief, Bryce Linden, and editorial staff, Nancy Seymour, Will Borin, and Mike Moudy have put together a first-rate showcase of student research featuring the work of rising scientists, artists, and scholars. It was my pleasure to be able to join this energetic editor and staff and their advisor, Dr. Kyle Christensen at a brainstorming session outlining the future of this journal. They have articulated a bold vision that expands the possibilities for undergraduate research and scholarship at Columbus State University. To that end, they are soliciting faculty mentors for student scholars, working with the deans of the individual colleges and academic units, planning the initiation of multiple publications each year, and implementing a year-round rolling submission process that is aimed at increasing submissions and opening up the review process.

Promoting student research is critical to the generation of the currency of tomorrow: ideas. The intellectual capital on this campus is our greatest asset. Momentum is a culture medium that serves to grow ideas that will lead to the innovation so important to our future.

Again, my congratulations are in order to this staff and to their dedicated advisor. I know that you will be as proud as I am of the work in this volume of Momentum.
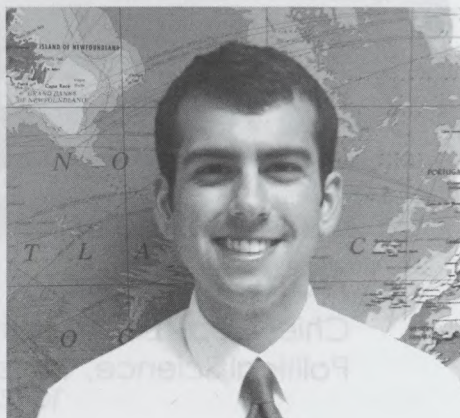
Dr. Tom Hackett, Professor

Provost and Vice President for Academic Affairs

Letter from the Editor-in-Chief

When starting at Columbus State University in 2008, I never would have imagined that I would serve as Editor-in-Chief for *Momentum*, Columbus State's leading research journal. I believe with strong conviction that *Momentum* will significantly raise the awareness and production of student research at this University.

The editorial team and I decided at the beginning of this term to create a strong platform for undergraduate research at Columbus State. To fulfill this goal, we want to encourage faculty involvement in undergraduate career development mentoring initiatives. On a personal note, I would not be where I am today if it were not for the guidance of the faculty members at the Political Science department. Mentoring is an integral part of the undergraduate research process and I encourage every faculty member to continue his or her efforts on this front.

The undergraduate research we received this year is a true representation of Columbus State University's growth and development. My goal and hope is for Columbus State University to lead in the University System of Georgia in research advancement and development. I am truly grateful for the opportunity to serve as Editor-in-Chief of *Momentum* and I look forward to seeing great things from Columbus State!

Bryce Adam Linden

Bryce Linden
Editor-in-Chief
Senior, Political Science

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Momentum's Honorary Faculty Mentor of the Year:

Dr. Kyle Christensen
Social Research Center, Director
Assistant Professor, Political Science

Written by: Dr. Gregory Domin, Associate Provost

Dr. Kyle Christensen was my student in political science at Mercer University a decade ago, distinguishing himself from the very best students in our discipline, taking an active role in clubs, scholarship, and a whole host of other activities. It came as no surprise to us in the department when he was admitted into West Virginia's doctoral program in Political Science, where he continued to distinguish himself from the best and brightest at that fine institution. In 2009 Dr. Christensen joined the faculty in Political Science at Columbus State University where he continues to distinguish himself today.

He currently serves as Director of the Social Research Center (SRC) assisting both faculty and students with their various research projects. He continues to teach Research Methods and International Relations courses in political science and the Master's of Public Administration. He serves as the faculty advisor to CSU's chapter of Pi Sigma Alpha, Political Science's student honor society. And, he continues to publish his research in quality peer-reviewed journals.

This last point is key. Dr. Christensen has a passion for assisting both our undergraduate and graduate students in their research endeavors. That is why he is such a valuable member of Momentum, CSU's student research journal. Dr. Christensen has put in countless hours helping launch CSU's journal along with his other myriad responsibilities. This comes as no surprise to me. It is the same kind of drive he exhibited when he was my undergraduate student a decade ago. In recognition of Dr. Christensen's all around efforts here at Columbus State University, I want to personally thank him for all of his tireless efforts to raise the profile of our university. I can honestly say that my student has far surpassed his old professor. I could not be more proud to call Dr. Christensen my colleague.

Undergraduate Research Matters

Dr. Shamim Khan

"Engaging students in undergraduate research and inquiry is one of the most effective ways to help students to begin to think like a chemist, historian or engineer, which arguably is one of the core graduate attributes for most discipline-based degree programmes" (Healey & Jenkins, 2009). Engaging in research means the students' involvement with their field of study is no longer a passing interest with the focus on succeeding in course homework and exams. Undergraduate research is the initiation of a potentially long-term commitment that can open new doors. This commitment to one's field of study is what can make study a more worthwhile and enjoyable experience.

Undergraduate research not only attracts better students, it can actually make students better. And I say this from my personal experience. So, what is in it for the faculty? Having your student present the work at a conference or publishing it no doubt brings a lot of personal satisfaction, but it also has a number of quite tangible benefits. You get a highly motivated student, eager to learn and try out new ideas and tools; perhaps, some of these you yourself had wanted to investigate in the past but never found the time for; you contribute to student mentoring and to the level of student as well as faculty research at CSU, and last but not least, quite likely, you set your student on a path to even greater achievements here at CSU and beyond.

Now, time and motivation are of the essence here. Students these days are busier than ever – many might think they don't even have the time to find out what research is all about, let alone consider how it could benefit them. But, once engaged, they can surprise themselves just as much as their mentors. I once heard an experienced mentor talk about what she liked best about her undergraduate research students – "they don't know what's not possible!" The biggest obstacles to student mentoring for the faculty, on the other hand, are lack of time as well as resource. Mentoring an undergraduate can require a significant portion of your time and patience, especially during the early weeks. Many might justifiably feel that they hardly have any time left for anything like mentoring student research, especially at a teaching-focused institution like ours. But, what if we consider undergraduate research as a component of the overall teaching and learning experience for both faculty and student, and try to integrate our research into our teaching?

Just as an example, student research projects sometimes materialize as an offshoot of an interesting end-of-semester course project, and also, don't many of us get ideas for course projects from topics of our own research interests?

While the issue of time can be a difficult one, help is available with resources. Since fall 2009, CSU's Office of the Provost has been awarding grants to students engaged in research, scholarly and creative activities under the direction of faculty mentors. The purpose of these grants is to support and promote such efforts by our students at both the undergraduate and graduate levels. These grants, usually limited to $300 per student per project, are awarded

during the spring and fall semesters, with calls for applications going out at the beginning of each semester. Applications for the Student Research and Creative Endeavors (SRACE) grant are reviewed by the SRACE committee consisting of representatives from all CSU Colleges and the Library. So far, 205 grants, totaling $53,807 have been awarded to support purchase of equipments, software and other supplies, and to help with conference travel by students. Details of the grant and the application form for the recently completed spring round may be viewed at:
http://aa.columbusstate.edu/student_RACE_grants.php

The currently paper-based application system is expected to become fully electronic and on-line from fall, 2012. The deadline for the fall semester SRACE grant applications is September 7, with notifications starting on September 24.

So, now is the time to speak to your professor or your student, and to find out how you can work together to do something about that idea you have been carrying around in your head. You won't be disappointed, even if you end up doing something a little different from what you had in mind to start with. Undergraduate research does matter!

References

Healey M, Jenkins A. (2009) Developing Undergraduate Research and Inquiry. York: HE Academy 2009. Available at:
http://www.heacademy.ac.uk/assets/documents/resources/publications/DevelopingUndergraduate_Final.pdf. Accessed 21 March, 2012.

Shamim Khan is a Professor of Computer Science and Chair of the Student Research and Creative Endeavors Committee.

Social Research Center

Dr. Kyle Christensen

Students at Columbus State University have an excellent opportunity to engage in research collaborations with The Social Research Center. The center is located in Arnold Hall 210 and provides research assistance to students, faculty, and community partners. The Social Research Center promotes partnerships that include student projects, faculty supervised research, and applied research opportunities with community organizations. This short outline of the Social Research Center focuses on a few unique aspects of the office including applied student research, development of research skills, and networking across departments.

Applied Student Research

Students seeking assistance with projects for presentation at a conference or development of a peer-reviewed article should stop by the Social Research Center. The staff at the Social Research Center is willing to help students develop their research project and locate faculty members with a shared interest to gain advice or assistance. There are also opportunities for students to work on faculty led projects in which students play a meaningful role while receiving mentoring related to the research process. This provides an excellent opportunity to gain valuable experience that can be applied for professional employment or graduate study. In addition, the faculty and staff working with the Social Research Center have agreed to assist students that they work with on their undergraduate research projects. These range from student presentations at conferences, development of a colloquium presentation, or submission of a paper to a peer-reviewed journal.

Development of Research Skills

Development of student research skills is a key part of the Social Research Center's mission. This includes hosting academic courses in the Social Research Center's computer lab in Arnold Hall 204. The staff of the Social Research Center makes special visits to classes upon request to talk about a research related topics. The Social Research Center also promotes University and College activities related to research to provide additional training venues.

Students also have opportunities beyond classroom exercises or training seminars. Columbus State students receive hands-on experience working directly with faculty research projects and collaborating with faculty on services for community partners. All Social Research Center projects that have direct student involvement include the goal of a completed student project. These include research presentations or completed research reports for community organizations.

The Social Research Center staff can also assist students in locating resources for research. These resources include funding opportunities, research internships, fellowships, and assistance locating potential student or faculty collaborators. This is particularly important for students who are interested in pursuing interdisciplinary projects that require expertise from departments that are unfamiliar.

Student Research is at the core of the Social Research Center's mission. New research opportunities and programs routinely become available. If you would like more information about the Social Research Center please find look online at http://research.columbusstate.edu/src/ or you may contact the Director, Dr. Kyle Christensen at (706) 565-3526 or by email Christensen_kyle@columbusstate.edu

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Creating a Business Plan

"Clearly, writing a business plan is not traditional research in the sense of using the scientific method, but it is an experience that requires one to gather information in a systematic manner to "sell" an idea to the reader who may be an investor. I think there are two real challenges of writing a business plan. The first challenge is the uncertainty of the process. You believe it is a good idea. You may be rigorous and systematic in your process, but it is still subject to the opinions, experiences and biases of others. The second challenge is balancing left-brain and right-brain thinking. You must be both logical and creative."

Dr. Kirk Heriot

"Crafting a thorough, well-laid-out business plan is a challenging task, but definitely worth the effort. It forces you to think about all of the little details that will truly make or break your business, regardless if you have "the BEST IDEA EVER" (which, of course, you do). You have to think beyond your target market, and how best to reach them. You have to think three to five years down the road in terms of operating costs, and how to develop your market to sustain your business in the unknowable future. Your business plan is not only a marketing piece for potential investors, but also an operational manual--how you plan on implementing and maintaining your idea. I highly encourage would-be entrepreneurs to take the time to outline their thoughts into a cohesive business plan and get plenty of feedback from trusted colleagues. Often your peers will provide you with game-changing insight about your product, market, or model that you may never have considered otherwise."

Kat Canella
MBA Graduate
Program Coordinator, Continuing Education
2nd Place Business Plan Competitor

Columbus State University's Turner College of Business will be offering **Introduction to Entrepreneurship (BUSA 3175) for** the fall '12 and future semesters. Introduction to Entrepreneurship will provide skills that will help students from any major who want to pursue applied business research. This course is intended to help students build a solid foundation in terms of vital role played by entrepreneurs and entrepreneurship in the 21st century global economy. Entrepreneurship is approached as a way of thinking and acting, as an attitude and a behavior. Our emphasis is on entrepreneurship as a manageable process that can be applied in virtually any organizational setting. The course will emphasize sustainable entrepreneurship or entrepreneurship over life cycles of people". Any questions pertaining to Introduction to Entrepreneurship can be directed to Dr. Kirk Heriot, *Crowley Chair of Entrepreneurship* at heriot_kirk@columbusstate.edu.

Using Opaque Predicates to Obfuscate Metamorphic Malware

Rodrigo Sardinas, Computer Science-Systems

Abstract

There is an ever-persistent race against the people who write Malware and those that write the Anti-Virus engines. This has been going on for some years now, with one occasionally pulling in front of the other for a short while, only to get one-upped shortly after. Malware today is more efficient and malicious than it has ever been before, and the trend is not stopping. One of the techniques malware employs today to evade anti-virus engines is called metamorphism. It is the ability of a program to transform itself into something that looks different, while still keeping its functionality. One of the prominent methods that anti-virus engines employ depends on being able to identify a program and then extract what is called a signature from it to be able to detect the same program in the future. In our research we take a look at some of the techniques used by metamorphic malware, currently the most sophisticated form of malware. We look specifically at opaque predicates, and how they are used to make it more difficult to determine whether a program is malicious, and to make variants of itself that, on the outside, appear to be different programs. We explain what an opaque predicate is, how to make a strong opaque predicate, how to use them, and how they are currently being used today for both good programs as well as malware. We then go into detail about a program that we are developing that behaves as metamorphic malware does. Our program is able to produce variants of itself, employing opaque predicates to make transformations to the control flow of the new program which make the variant appear to be a different program.

Introduction

The history of malware is an interesting one. The following are some recent events in which malware had a pretty big impact on society; these incidents were taken from a timeline at Infoplease [7].

In 2001, shortly after the September 11th attacks, the Nimda virus infects hundreds of thousands of computers in the world. Worms increase in prevalence. Sircam spreads personal documents over the Internet through email. CodeRed attacks vulnerable web pages, and was expected to eventually reroute its attack to the White House homepage. It infected approximately 359,000 hosts in the first twelve hours.

In January 2003 the relatively benign "Slammer" (Sapphire) worm becomes the fastest spreading worm to date, infecting 75,000 computers in approximately ten minutes, doubling its numbers every 8.5 seconds in its first minute of infection.

First discovered in November, the Conficker virus is thought to be the largest computer worm since Slammer of 2003. It's estimated that the worm infected somewhere between nine and 15 million server systems worldwide, including servers in the French Navy, the UK Ministry of Defense, the Norwegian Police, and other large government organizations.

Is anyone or any technology really safe from harmful programs? The most recent malware, Conflicker, represented on the timeline is estimated to have affected between 9 and 15 million server systems worldwide. The details are above for the date 2008. In a recent security that Microsoft offers bi-annually [12], their reports show that for the first quarter of 2010, they cleaned 11,025,811 malicious programs from computers in the United States alone. The following is a table taken from Microsoft's SIR [12].

Table 1 : Results for computers cleaned 1st Quarter of 2010, Microsoft SIR V9
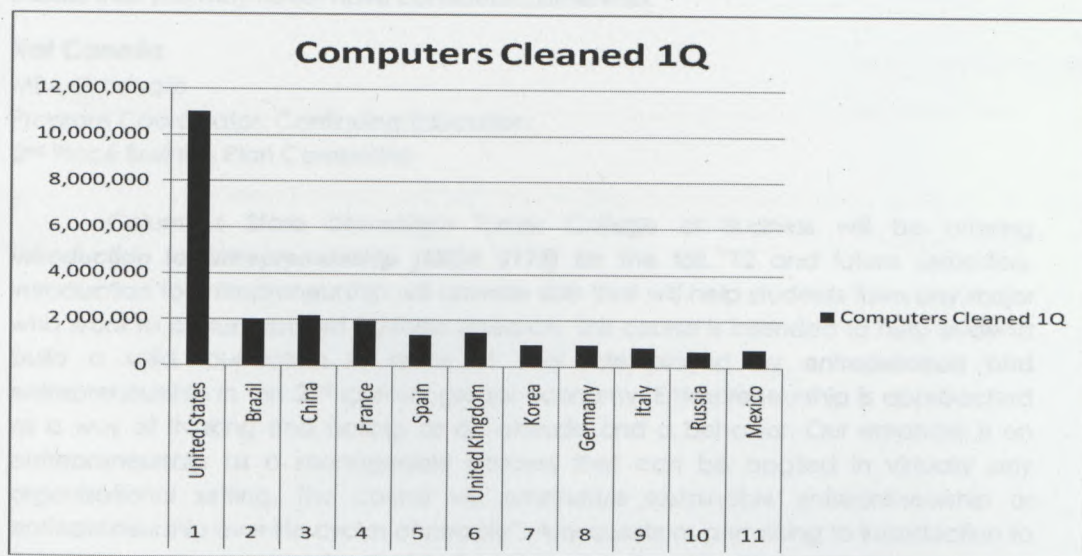
Compared to other countries, the malicious programs removed from computers in the United States alone is more than the amount removed from the following seven countries combined, and this is only the malware that people are aware of.

One major issue that people are currently facing is Botnets. Microsoft's SIR spent roughly the first 50 pages of their report discussing what they referred to as Botnets. To be brief, a Botnet is an automated software program that performs tasks on a network with some degree of autonomy [12]. They mentioned that the majority of Botnets make use of Internet Relay Chat (IRC) networks. An IRC is simply an internet chat protocol designed for group communication [12]. One of the commonly used tactics that these bots employ is called a Denial of Service attack, or DDOS. This is when a computer or server is flooded with so much internet traffic that it prevents others from using it, basically shutting down the site that that server is maintaining.

A current example of the use of Botnets can be found in the group that calls themselves Anonymous. Anonymous originated in 2003 from a site called 4chan.org [9]. The group has been responsible for a number of well-known DDOS attacks using Botnets or something similar to them. Here are some of the more notable attacks they are known for. On December 2010 Anonymous takes down

PayPal, a Swiss Postal Service Bank, MasterCard, and Visa [10]. In February 2011, the group is credited for shutting down the Tunisian government's sites, servers and state-run media channels, in an effort to assist the Tunisians in

overthrowing the government of President Ben Ali [1]. And again in February of the same year, the group is credited for paralyzing the Egyptian government's web sites in support of the anti-government protests [15].

We are not here to judge whether this group's actions are good or bad, but these examples and the statistics given in Microsoft's SIR are just a few things that show effect that this kind of attack can have, for better or for worse, and how it is still relevant today, if not even more relevant today than ever.

Botnets are just one type of malware, there are many more. It is interesting to see the techniques people employ when making malware. We will be discussing some of these techniques in the following pages.

2. OPAQUE PREDICATES

2.1 DEFINITIONS

We will begin by defining what an opaque predicate is. We borrow this definition from Collberg et al. [4]. They define a predicate P, a Boolean expression, to be opaque if its outcome can only be deduced by another party with great difficulty, but the outcome is well known to the party implementing it. It should be known from the start. For example, the simple expression, if (1+1 == 2), will always evaluate to true. If used as a predicate the implementing party will know, when implementing it, that the result will always be true.
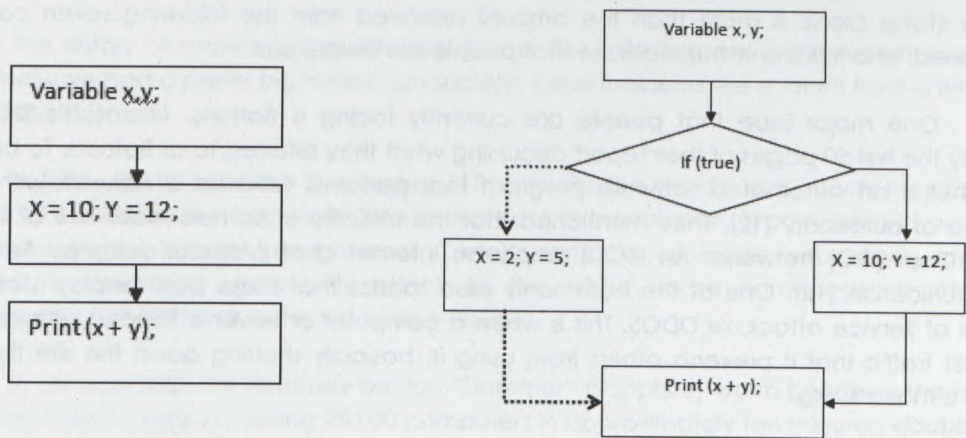
Figure 1 A : Original Control Flow. Result = 22   1 B : Altered Control Flow. Result = 22

A variant is program that is a different version of another program. It is generally the case that the program will look different, but behave exactly the same. There are times, however that the program looks and behaves differently.

We will define dead code as code that is irrelevant to the program, and possibly never reached, which will not affect the intended result of the program in any way.

2.2 Implementation and Proper Use

Opaque predicates in and of themselves are not enough. They should be used with other techniques to make them effective. Typically, opaque predicates would be used to alter, or appear to alter, the control flow of a program. One technique that could be implemented along with opaque predicates is the insertion of dead code into the program. The use of an opaque predicate to seemingly alter the control flow of a program is illustrated in figure 1. In 1(a) we see what the intended result of the program is. In 1(b) we alter the control flow, to make it seem as if there could be more than one result, which is not true. We indicate the path that we know will be taken with a solid line. With the proper use of opaque predicates, this would force the other party to take both paths into account, as either is equally likely to occur. We see that they both converge and each produces a different result. Anti-virus software, which may have already recognized the program from figure 1(a) as being malicious, would not associate the program from figure 1(b) with the previous program, thus the program from figure 1(b) has successfully avoided detection and is free to execute its malicious code.

Opaque predicates have been used by programmers, for different reasons. Collberg et al. discussed using opaque predicates as a way to obfuscate a program so that other parties could not reverse engineer a program, thus stealing algorithms or formulas they had not worked for [4]. Arboit wrote of using opaque predicates as a way to watermark a program, to protect it against intellectual property theft [2]. Collberg et al. suggests that the number of opaque predicates a program contains is strongly related to how complex the program is, or seems to be [4]. A metamorphic malware author would want to hide the fact that two variations of his program are in fact variants of the same program.

Table 2: Number-Theoretical Opaque Predicates and Proofs

Identity	Proof
$\forall x \in \mathbb{Z} : 4 \mid x^2(x+1)^2$	An even number times an odd number will always be even. We're looking at 2 consecutive instances of x; x and x+1. Since we know the end result will be even, we will let x represent the result of x (x+1). Then: X = 2N X2 = (2N)2 = 4N2 4 is always a factor.
$\forall x \in \mathbb{Z} : 3 \mid (x^3 - x)$	(X3 – 1) = X (X2 – 1) X (X2 – 1) = (X – 1) X (X + 1) With 3 consecutive numbers one of them will always be a multiple of 3.
$\forall x, y \in \mathbb{Z} : 7y^2 - 1 \neq x^2$	
$\forall x \in \mathbb{Z} : 2 \mid x \vee 8 \mid (x^2 - 1)$	If x is even it is always divisible by 2. Therefore the second part of the identity concerns only odd values of x. If x is an odd number then: (X2 – 1) = (X – 1) X (X + 1) Therefore we have 2 consecutive even numbers. One will always only be divisible by 4, while the other will be divisible by 2. Since these numbers are being multiplied together, we have 2 x 4 which is 8. Therefore in every case the equation will be divisible by 8.
$\forall x \in \mathbb{N} : 2 \mid \left\lfloor \dfrac{x^2}{2} \right\rfloor$	For all cases where x is even it is already a multiple of 2. So there is only to look at the cases where x is an odd number. Let x = 2n + 1 We then have (2N+1)2 / 2 (2N+1)2 = (2N)2 / 2 + (4N) / 2 + 1 / 2 (2N)2 = 4N2 The floor of any even number is still an even number. The floor of 1 / 2 is 0 for which 2	0 is also true. Therefore in every case the equation is divisible by 2.

The simple example given in the paragraph defining what an opaque predicate would not make a very strong predicate. Collberg et al. mentions a few conditions needed for a strong opaque predicate. The predicate should not be one that can be cracked by static local analysis [4]. By this they mean that one should not be able to predict the outcome of an opaque predicate by examining one basic block of a control flow graph. They also state that opaque predicates should not be made from calls to library functions, which have documented well-understood semantics [4]. In this case the outside party could simply examine the calls to determine the outcome. Arboit states that a strong opaque predicate is a one-way predicate [2]. To paraphrase Arboit, there should be no method to deducing the outcome of a predicate that would be more efficient than simple random guessing.

2.3 Current Applications

There are a number of techniques people use to achieve this outcome. These include number theory [2], alias-analysis [4], and concurrency [5], among others. We will concentrate on predicates formed from number theory problems. Arboit mentions that most number-theoretical predicates are complex or one-way [2]. In Addition, these types of predicates are currently being used in implementations such as PLTO [14] ,a binary rewriting system that transforms a binary program but preserves its functionality, LOCO [11] ,a similar tool, and SANDMARK [6] a similar tool for java programs [13]. The examples from table 2 are complex predicates taken from Arboit and Collberg et al.

3. Experience Report

3.1 Overview

So far we have discussed some modern day malware menaces, as well as some popular techniques that malware authors, and legitimate program writers use to make their programs more difficult to decipher. Now we use some of what we have discussed to make a program that simulates malware. Our program is written in c++. It prints the string, "Hey, I'm malicious malware!". We make a variant of our malware and obfuscate the variant using opaque predicates. Our malware makes a new directory, examines the original version, makes a variant and saves it into the new directory. It then compiles the new version of the malware and saves the .exe into the same directory as the variant.
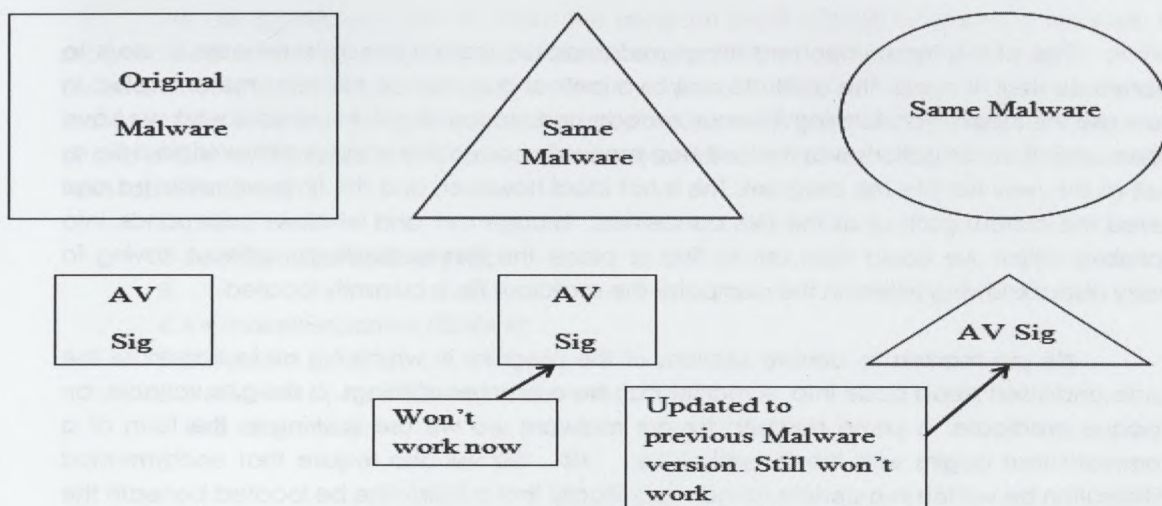
Figure 2: Malware morphing successfully avoiding detection from outdated AV signatures

Since this is an educational endeavor, we strive to keep the program as simple and as understandable as possible. The program is heavily commented and formatted for readability. Our main goal is to demonstrate the use of techniques that malware authors employ when making malware, in particular, the use of opaque predicates in metamorphic malware.

3.2 Purpose

Borello states that a metamorphic virus, a type of malware, is the most sophisticated form of a virus [3]. Metamorphic malware rewrites itself so that each new variant looks different than before. One method that anti-virus writers currently use to detect malware is to extract a signature. This signature is something extracted from the program that uniquely identifies it. In figure two above, we see why metamorphic malware is so deadly. An av utility extracts a signature, and then the malware changes itself; the signature is no longer valid. By the time the signature is updated another variant has been produced that is, yet again, different than before. Typically metamorphic malware transforms itself at the assembly level or binary level. Win32/Apparition, however, carried around its source code, and upon infection, would transform the source and recompile itself, producing a new variant from the source code [16]. Szor states that it is much easier to transform malware in this way, and warns that although it may not have currently been a big problem, it will become on, therefore one cannot turn a blind eye to it [16]. A perfect example of his prediction coming true is a worm, another type of variant that is self sufficient which does not need another file to carry out its malicious activity, called Agobot. This particular malware is written in c++. Another thing to note about Agobot is that as it evolves it also acquires new malicious abilities [8]. Aside from acquiring new abilities the malware we are making for our research is very similar.

3.3 Details

One of the more important things metamorphic malare needs to be able to do is to reproduce itself. It needs the ability to make variants of itself, hence the term metamorphic. In our case this means transforming the source code and recompiling it. In previous work we have done, one of our limitations was that we had manually coded the address of the original file as well as the new file into the program. This is not ideal however, and this time we retrieved and saved the current path of all the files concerned, through c++ and windows commands, into variables which we could then use to find or place the files accordingly, without having to worry about knowing where in the computer the malicious file is currently located.

We use markers to denote sections of the program in which it is ok to transmute the code and insert dead code into. A marker can be a number of things, a string, a variable, an opaque predicate, a prime number; for our malware we will use a string in the form of a comment that begins with the @ symbol, i.e.: //@ . We will also require that each method initialization be written in a certain format, specifically that a blank line be located beneath the initial scope operator. We will mark the beginnings of our method initializations with the @ symbol mentioned previously. i.e.:

```
//@
void doMaliciousBehaviour(){
(empty space here)
cout<<"Hey, i'm malicious malware!\n";
```

Here is a breakdown of the code above. At line one, we place our marker. This will alert the malware that it has permission to change the following section of code in the program. Lines two and three are also part of the alerting process. Although it is normal to write a program in this way, our program, which is also the malware itself, stipulates that in addition to placing the marker, the next two lines must contain, first a method initialization, then a blank line. It is important when malware makes changes to itself, that the malware still be able to work when done. So one has to be very careful what one changes in their program and where they do it. Line four is simply the method body. We will insert our opaque predicate into the empty space along with dead code. There are a number of more crafty ways to obfuscate malware, but since our purpose is simply to demonstrate these principles we will not make it difficult.

We decided to use opaque predicates from number theory. Certain number theory problems are known to be one-way or complex, refer to section 2.2 [2]. We borrow a few of these from Arboit and Collberg et al. The identities we use in our program are those listed in Table 2. We have a separate method for each of the identities in the table that will return a Boolean value based on the result of one or two global variables contained in our program. We give the variables a different value each time they are used so that it will not be possible to determine by static analysis that a result will always be the same. We do this by creating a rand object, an object that will create random numbers or characters, seeding it initially with the current time, so that the value will always be different each time you run the program and then incrementing the value by one, each successive time it is called.

We use global variables to make the program more difficult for slicers to analyze. A program slicer attempts to logically separate a program into smaller dependent parts to better determine what a program is doing. By calling the global variables in each of our methods, it makes it difficult for the slicer to reduce our malware into individual parts. Below is an example of one of the methods we use to form an opaque predicate. We are using the fourth example from table two here.

```
1. //@
2. bool opaquePredicate4(){
3.
4. x = makeRandomInt (TIME++);
5. int result = ((x*x)-1);
6. if (x%2==0 || result%8==0) return true;
7. else return false;
8.                                    }
```

We see again our marker at line one. At line two we initialize our method. Line three is blank; we've already discussed the reason for this. At line four, we call the global variable x and place a random number inside. In order to not make the code too difficult inside of our if statement, we calculated the second half of the identity and saved it into a single variable in line five. In line six and seven we implement the if statement that is our identity. We know that each time we call this method, the result will always be true, so it is safe to use this anywhere we wish to show the illusion of branching from the original control flow of our malware. To use this method, we would simply call it and treat it as a true statement. Figure three demonstrates this. The dotted line represents the false branch introduced into the control flow, which we know will never be taken since we know that our opaque predicate will always return true.
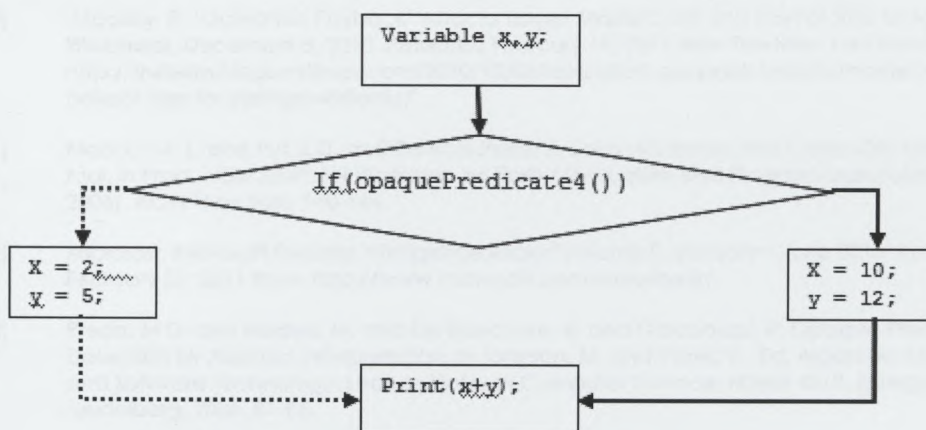
Figure 3: Introducing a false control flow

4. Conclusion and Directions for Further Research

Currently our malware is able to dynamically locate itself, copy the original source code and transform it, then compile it to make the new variant, giving both random names, and place both the new source and variant into the randomly named folder.

Our research is still limited in that we are still learning about the capabilities of the c++ language and as such, most likely did not use the most efficient search methods and have not implemented some of the things we would like to have done for lack of knowing how to do so. We still have to manually type in the location of the compiler into the program since; 1) we have not learned how to implement an exhaustive search of a computer to find a specific file; 2) security concerns at the University. We have also not attempted to automate the variant generation process, nor have we attempted to send the new variant over a network, globally or locally. We can cite the reasons above in this case as well.

Some plans for future research include, but are not limited to: 1) adding exhaustive search capabilities to our malware to enable it to find a suitable compiler; 2) automating the variant generation process; 3) sending variants of the malware, or a copy in the event that no suitable compiler can be found with which to generate a variant, to another machine; 4) implementing other techniques used by malware authors, such as split variables and dynamically mapped tables; 5) and it is our ultimate goal in producing this malware, that the act of doing so will allow us to find factors that must be common in all forms of metamorphic malware, which in turn will provide us insight into weaknesses of malware, thus providing us a way to successfully detect metamorphic malware.

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Study Abroad
Cuernavaca, Mexico

Brooke Strain

Last year I traveled to Cuernavaca, Morelos, for a study abroad opportunity through Columbus State University. Studying abroad opened many opportunities for me. Anytime I have a chance to brag about my experience I take advantage of it. Many individuals seemed very impressed that I could handle a trip that rigorous and long. With my major being Spanish, this study abroad trip has not only helped speed up the process of getting my degree; but has added so much more depth to my learning.

Last year, after returning home, I noticed that my listening comprehension and also my response rate were much better, just because of those four intense weeks. There are many individuals who scoff or who are scared of the idea of even traveling to Mexico. But while there, I learned that sometimes you have to judge things for yourself and not always listen to the crowd and what they say. Prior to my trip, people questioned me about why I would put myself in danger. Looking back, our group encountered not even one single act of violence or suspicious behavior. Instead, we thought outside the box and got to see another part of the world that others often avoid. I think, most importantly, what I took from Mexico was to learn to think outside the box. It changed my views on how I viewed other individuals and also it taught me not to make assumptions or to judge others without seeking the information for yourself. Cuernavaca was a life changing experience and I can't wait to experience it again this year.

The Temptation of Christopher Marlowe
Laurie Nix, English with Literature Concentration

Christopher Marlowe's outrageous reputation makes him one of the most fascinating of all literary figures. He was thought to have been a government spy. Rumors circulated wildly about his sexuality and liaisons. And of all the allegations made about Marlowe, his supposed atheism incited the most contempt from his contemporaries. Many of Marlowe's works clearly reflect these accusations. His characters and plots, which often have underlying themes of subversion and dissent of popular beliefs of the day, echo a great deal of what was said about Marlowe. While all of his works have elements of the taboo – or what would have been taboo during the Renaissance – some blatantly rebuke the idea of organized religion and many of the doctrines and beliefs that stem from adherence to it. The title character in Tamburlaine the Great considers himself to be a God-like figure, commiting acts of utter cruelty through blind ambition. However, he neither faces any real justice for his deeds, nor does he seem to receive any ultimate judgment. Barabas, the lead character of The Jew of Malta, blatantly refuses to convert to Christianity even in the face of total ruin, and both Christians and Jews face tragedy throughout the play, largely due to the Christian doctrines they are forced to follow. And the title character of Doctor Faustus whole-heartedly accepts an eternity of damnation in exchange for earthly power and knowledge.

Marlowe's alleged atheism made him the subject of intrigue, contempt, and, to this day, fascination. One of the most interesting aspects of Marlowe's writing, however, is the ambiguity and potential multiple meanings behind much of his most seemingly subversive and controversial literature. Marlowe did nothing to quiet or deter the rumors about him that were as popular as his plays themselves. If anything, he egged them on with his writing and behavior. And while it is still speculated on whether many of the allegations against him were true, the actions and fates of the lead characters of Tamburlaine the Great, The Jew of Malta, and Doctor Faustus all contribute heartily to Marlowe's still prominent reputation as an atheist.

One could make many Christian and Biblical allegories for Marlowe's two-part epic Tamburlaine the Great. The corruption of these themes – and corruption in general – is an essential part to the play, however. Tamburlaine starts out as a shepherd of humble means and lowly status. Humility, however, is a trait that Tamburlaine does not possess. He immediately takes action toward gathering followers and becoming as powerful as any man has ever been. "Lie here, ye weeds that I disdain to wear!" he cries, as he removes his shepherd's cloak in a very symbolic gesture of leaving his modest beginnings behind him. "This complete armour and this curtle-axe / Are adjuncts more beseeming Tamburlaine" (Marlowe 1.1.2.41-43). The deliberate and drastic step away from innocence, represented by the shepherd's cloak, a Biblical symbol in and of itself, to violence and corruption, represented by the armor and axe, seem to signify Tamburlaine's move toward moral corruption and away from a life of purity and innocence. Tamburlaine and his servants immediately set out upon enslaving people who are to become his "forcèd followers / Till with their eyes they view us emperors" (Marlowe 1.1.2.66-67). And the promises he makes in order to woo Zenocrate are those of purely material wealth – "They garments shall be made of Median silk, / Enchased with precious jewels of mine own..." (Marlowe 1.1.2.95-96) He does not promise her love. He does not promise her companionship. He only promises her possessions, the desire of which is condemned in traditional Christianity.

Indeed, Tamburlaine seems in many ways to be the embodiment of all that is against Christianity while being painted as something of a hero. He, in fact, exhibits elements of pure sadism in his terror of others during his search for ultimate power. His reign is one of "an arithmetical progression of atrocities" (Carter 80). Tamburlaine exhibits a most un-Christ-like "aggressive desire to break laws, torture victims, kill virgins," and, in direct opposition to Christian doctrines of morality, "Tamburlaine believes in a kind of 'moral' structure in the universe, an inversion of traditional moral order in promoting evil in its purest form" (Starks 180).

Marlowe shows still more irreverence for religion in his characterization of Tamburlaine by the other characters' descriptions of him and by Tamburlaine's own ideas of being something of a god. The tyrant "repeatedly refers to his cosmic fate, calling himself 'the scourge and wrath of God'" (Starks 180), and, much like a god, he seems to wield power over every place he goes and everything he touches. Assuming Marlowe is painting Tamburlaine as a God-figure, the fact that he is nothing more than a tyrant speaks volumes as to Marlowe's willingness to call to question the Christian depiction of God and potentially Marlowe's own feelings toward the figure of God Himself. Tamburlaine is "a destructive force in a universe that, far from being indifferent to humankind, actively produces evil with its Nature in a quasi-religious devotion to savage brutality," and he seems to be entirely "devoted to evil for evil's sake" (Starks 181). Tamburlaine seems to be an image of God the way Marlowe was reported to have viewed Him – a cruel tyrant bent on complete control.

One of the most prominent of all the accusations about Christopher Marlowe was the "Baines Note," an infamous documented account of the allegations against Marlowe by some of his contemporaries. In this note, it is stated that Marlowe "had denied the divinity of Christ and the authority of the Scriptures; Moses was a 'juggler', Christ a sodomite, and religion nothing more than a means of social control" (Davidson 129). Knowing that these highly unorthodox opinions were at least thought to have been said by Marlowe, an audience can envision Tamburlaine in a light that depicts him as someone using force, and, to an extent, religion, to garner control and power. By comparing himself to gods, he justifies his actions as just and worthy. In response to being accosted by Cosroe, he responds, "The thirst of reign and sweetness of a crown, / That caused the eldest son of heavenly Ops / To thrust his doting father from his chair / And place himself in th'empyreal heaven, / Moved me to manage arms against thy state. / What better precedent than mighty Jove?" (Marlowe 1.2.4.52-57) It is notable that he cites Jove, a non-Christian deity, as his inspiration. This seems to indicate that Tamburlaine is not swayed by any one deity or religion any more than another, but that it is power and influence that he craves. Through his behavior and reasoning behind it, he is at once the God-like tyrant and the exploiter of religion.

Possibly Tamburlaine's ultimate act of irreverence and God-like arrogance (and in Marlowe's alleged view, God-like tyranny), is the burning of "all the heaps of superstitious books / Found in the temples of that Mohamet" (Marlowe 2.5.1.173-174). This symbolic condemnation of another religion once again displays Tamburlaine's dual God and God-exploitation character. He feels entitled to burn the holy books of other religions, while calling them "superstitious," as opposed to showing them any formal or respectful regard. Marlowe "has the conqueror burn a Koran on stage and challenge Muhammad to materialize, 'if thou have any power...and work a miracle'" (Haught 33). This lack of respect can echo both Christian arrogance and dismissal of other religions, as well as Marlowe's (and possibly Tamburlaine's) dismissal of religion on the whole.

The Jew of Malta is a play with a great deal of religious significance surrounding the plot and the characters. Barabas, the Jewish protagonist, is at first a victim with whom the audience (a modern audience, at least) sympathizes. At the heart of this play is the tension between Christians and Jews, the use of Christianity to exercise control and persecution, and the cruelty committed by both Jewish and Christian devotees, who excuse their behavior through their religions. Similarly to Tamburlaine, there is a theme of using religion to garner control and wage war. The prologue to the play is appropriately delivered by Machiavelli, called "Machevil" in Marlowe's text. "I count religion but a childish toy / And hold there is no sin but ignorance," says Machevil. He goes on to beg that the audience have sympathy for the Jew of the play, and "let him not be entertained the worse / Because he favours me" (Marlowe). There is still more of Marlowe's signature ambiguity in Malta. While Barabas is ruined by his Christian adversaries merely for being a Jew, he is also introduced to the audience by a man who, due to his theories on controlling the masses, is viewed as a supreme villain by a great many people. This alone alters the audience's, and potentially Marlowe's, view of Barabas.

Taking his cues from Machiavelli, regardless of his plight as a Jew in a Christian-dominated culture, Barabas earns a reputation as a "heroic villain" (Anastaplo 120), wielding crafty control over the lives of those who have persecuted him and taken his wealth. Ferneze, the governor, demands that the Jews pay one half of their estates to the government or else convert to Christianity immediately. If any Jew refuses to comply, he will be stripped of all he possesses, and such is the fate of Barabas. He refuses to abandon his faith and has his wealth taken from him. Marlowe, through Barabas, questions how any justice can be in doctrines that allow for this treatment, asking, "Is theft the ground of your religion?" (Marlowe 1.2.96) Ironically, these same Christians who are the ruin of Barabas on the basis of his religion make him something of a martyr. The governor, Ferneze, in still more wrongdoing cloaked in religious piety and loyalty to the state (another somewhat Machiavellian trait), tells Barabas, "No, Jew, we take particularly thine / To save the ruin of a multitude" (Marlowe 1.2.97-98).

While at this point the audience may sympathize with Barabas, and even respect him for refusing to abandon his beliefs, Marlowe keeps the ambiguity about his characters strong, for Barabas uses his daughter in a ploy to retrieve some of his stolen wealth by making her pretend to convert to Christianity and join a nunnery, into which Ferneze has transformed his mansion. Barabas quickly proves himself more proud and fond of his material wealth than of his family or any human connection. While his daughter recovers some of Barabas's wealth in the nunnery, he remains bound by vengeance. Through lies and manipulation, he "manages to provoke a deadly duel between two suitors of his beautiful daughter," one of whom, Lodowick, is the son of the Maltese governor, Ferneze, who bankrupted him (Anastaplo 120). While an audience's sympathies may have lain with Barabas at first, his abrupt crossing over from wronged and persecuted Jew to malicious and vengeful murderer is undeniably disturbing.

While one can question whether Marlowe is painting Barabas in such a villainous light due to an anti-Semitic attitude that was prominent in his time, his depictions of the Christians is no more flattering. A worthy question about Barabas and the play as a whole is that of whether the Jews are "simply used for investigating matters, such as Machiavellianism and Christian theology, two 'phenomena' that can seem to be intimately related" (Anastaplo 121). While Marlowe's dealings with the Jews and his depiction of Barabas in The Jew of Malta may not be entirely sympathetic or enlightened, and even if he did merely use the persecution of the Jewish people as a means to bring to light the exploitive and power-hungry capabilities of Christianity, the fact that anti-Semitism was the example he chose to use to portray the harmful and Machiavellian potential of religious tyranny speaks volumes. Whether the Jews are a device in this instance or not, Marlowe still shows clear reticence toward organized religion, painting it just as Machevil describes it in the prologue.

Again, like Tamburlaine, Barabas also becomes as much a villain as those who exploit their religion to destroy him. While he spends a great deal of the time "adopting outrageous roles, plaguing and exposing the hypocrisy of the Christians" (Hattaway 200), he is also responsible for the death of his daughter's two suitors, and, subsequently, his daughter, willingly murdering every resident of the nunnery in which she lives in order to assure that she is killed. And, also like Tamburlaine, the "heroic villain" Barabas must meet his demise at the end of the play. Unlike Tamburlaine, however, Barabas's end comes at his own hand, in a trap that he himself devised for his foes, which seems to deliver more justice to his character than Tamburlaine's sudden and anti-climactic death. And to make Barabas pay for his transgressions in this way, coming from Marlowe, seems to bring more irony, or even comedy, to the play than any kind of moral lessons of reaping what one sows.

Of all the characters Marlowe wrote, probably his most famous, his most subversive, and most definitive of reaping what one sows, is Faustus. Of all his plays, Doctor Faustus deals most directly with religion, and shows the most irreverence for it. The play deals fearlessly with the ideas of religion and of rebuking it, considering that most of the "drama of the period is nervous about theology, too conscious of its own secular frivolity to engage with the deepest elements in the Christian world-view; but Marlowe's play is frankly – thunderously – theological" (Nuttall 23).

Faustus, similarly to Tamburlaine and Barabas, represents two figures – a mirror of the fallen man, and, in some ways, a mirror of Lucifer himself. He represents the fallen man by his rejection of God's laws in a quest for knowledge. This quickly brings to mind the story of Adam and Eve eating from the forbidden Tree of Knowledge in Eden. Interestingly Marlowe has his title character wish for, above all things, and knowledge. Power is important. Wealth is important. But, for Faustus, it is knowledge that carries the most value. Upon signing away his soul with his own blood, Faustus begins to ask questions about books in which he "might see all characters and planets of the heavens" so that he could "know their motions and dispositions" (Marlowe 5.71-73).

Faustus also, in certain ways, mirrors Satan himself. He has the desire to throw off the chains that bind him – these chains being adherence to God's will so as to ensure him at least a chance in heaven. Like Lucifer, he rises up against all that is considered "good" and "Christian," so as to try to build himself up to be more equal with superhuman creatures, such as angels, demons, or God Himself. And Faustus demonstrates as much ambiguity as Tamburlaine and Barabas, having moments of apparent regret, bordering on repentance, and having an "engagement with the rituals of both worship and demonism" (Hattaway 215). Marlowe seems to be enjoying himself with these fluctuations in his characters. They dip their toes into whatever religion, belief system, government, etc., that is most appealing or convenient to them at the time, and use it for their own advantages. This, in and of itself, can serve as a strong atheistic critique of the dangers and hypocrisies of organized religion.

Faustus, like Tamburlaine, and like Barabas, must meet an end, and his is not without ceremony. Upon the stroke of twelve, the Earth gapes open to receive Faustus into hell. Faustus is dragged down by devils, crying out for mercy from the God he rebuked: "O soul, be changed into little waterdrops, / And fall into the ocean, ne'er be found! / My God, my God, look not so fierce on me!" (Marlowe 14.115-117) While this looks like an ending that conforms to the traditional "defy God, be eternally damned" theme of Christian ideology, coming from Marlowe, it seems to mean something else. In the context of the rest of the play, and recalling the fickleness already shown by Faustus (and, to an extent, Tamburlaine and Barabas) in regard to religion, this could very well be Marlowe taking yet another cynical jab at religion. This man only changes his mind (temporarily) about the deal he has made with the devil for fear of eternal damnation. Marlowe allegedly, at least according to the Baines Note, thought of religion as merely a means of social control, with the fear of eternal damnation playing a great role in the way people live their lives. For Faustus to want to return to God only in the face of what he has already willingly agreed to – damnation – seems to be an almost comedic depiction on Marlowe's part of the way people use religion to either control others or to dictate their own lives.

Christopher Marlowe has been the source of literary, scholarly, and religious debate since the 16th century, when he was in the midst of his very singular career. While he riled many a critic and theatre-goer in his day and long afterward, there are truly as many readers who deny true atheism on Marlowe's part as there are those who denounce him for ungodliness. While some make the claim that his plays outwardly and without reluctance show Marlowe's disturbance and displeasure with religion and those who conform to it (Astanaplo 121), others propose the idea that the period in which Marlowe and his accusers lived, the more prominent of whom were Richard Baines, Thomas Kyd and Robert Greene, all contributors to the Baines Note, was not only deeply and dangerously critical of non-belief, but "that the period lacked the mental equipment to reject the Christian religion: that intellectual unbelief was actually impossible in the sixteenth century." (Febvre) Marlowe's plays, even the most outrageous and seemingly subversive of them, are filled with clever and most likely intentional ambiguity. They can be read to fit cozily into a Christian orthodoxy as easily as they can be read to rise up against it. They are filled with fantastical plots, characters that are simultaneously heroic and tyrannical, and enough mixed messages and double meanings to fuel scholarly and literary debate from the time of their publication to the present day. However the plays are read and interpreted, it is Marlowe's signature ambiguity that allows for more questions to be asked about intent, and, potentially, about religion in general, an anomaly for a writer of the time.

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Creating an Invasive Species Index at Oxbow Meadows Using DNA Barcoding

Will Borin

The Fall semester of 2011, I was given an enlightening opportunity not only to be a part of the conservation genetics class here at Columbus State University, but I was also allowed to do hands on research using many of the techniques we learned about in our class. The cutting edge research that was used and applied to this research was DNA barcoding. Dr. Burgess has been a major player in developing a universal DNA barcode for plants with his participation in the International Barcode of Life (iBOL), a center of research whose main mission is to create a DNA barcode database for all of the species on the planet. This task seems quite enormous, but they are receiving help from many institutions, such as the faculty and students right here at Columbus State University.

A lot of samples needed to be collected and then run through the process of getting a DNA barcode. A bulk of the data used for my research was collected from conservation genetics classes that had come before me, but I was still able to get hands on experience with collecting some of my data. The first step was to go to Oxbow Meadows and collect samples from various plant species. This involves taking a clipping of leaf tissue for DNA extraction, and then taking a larger piece of the plant was clipped, pressed flat, and dried to create a mounted specimen to be used for taxonomic identification. The leaf tissue was then taken to the molecular lab where we began extracting the DNA from the chloroplast. We then took the extracted DNA and clipped it so that we had only a specific piece of the chloroplast genome called rbcL . I then took the rbcL DNA and performed PCR Amplification to create millions of copies of this small strand of DNA. These samples are then sent off to another institution where the DNA we have extracted will be sequenced and sent back to us in the form of a series of letters representing the bases found in DNA (A,C,G,T).

After receiving the sequences back, I was then taught by Dr. Burgess and Alicia Garcia, a graduate student, on how to process the sequence into a usable DNA barcode. These sequences were then checked against a database of other sequences, called GenBank, to determine if we had correctly identified the plant species. The ultimate end of this research was the confirmed identity of over 7 invasive species that are very prevalent at Oxbow Meadows. The locations of these invasive species were then reported to EDD MapS (Early Detection & Distribution Mapping System), a website that tracks the movement of invasive species. This helps biologists track and control these species. The last step is to upload all of the DNA barcoding data to the iBOL database. This research has been very intriguing and has given me interest in the field of genetics that I did not have before.

Effects of Eye Contact on Human Emotion

Breé Legere-Mahovetz and Cristina Pace, Psychology

ABSTRACT

When people maintain eye contact during a conversation, their communication becomes more meaningful and synchronized (Wiens, Harper, & Matarazzo, 1980). We were interested in whether receiving eye contact mattered for interviewees and if a participant's level of introversion/extraversion influenced their reported emotion towards an interviewer. Thirty-eight undergraduate students at Columbus State University were randomly assigned to receive eye contact or not receive eye contact during an interview setting. Participants who received eye contact rated their interviewer and her effect on their emotional state as significantly more positive than participants who did not receive eye contact. Our results were consistent with work by Tipton and Rymer (1978), who showed that eye contact garnered more positive assessment of interviewers and therapists. Although not significant, participants who were rated to have an introverted personality reported more discomfort (negative feelings) toward the interviewer in the eye-contact-received condition. Receiving eye contact appears to serve as an important social cue in communication; however, the emotional aspect of it--whether positive or negative--might be influenced by individual differences in personality.

Eye contact is powerful and important when engaging in conversation with other people. In western culture, eye contact is believed to be an essential part of the communication process. When a person maintains eye contact with another during conversation, people believe that the communication is more coordinated because eye contact serves as a speaker-listener turn taking nonverbal communication cue (Wiens, Harper, & Matarazzo, 1980). The idea of giving and maintaining eye contact while in a conversation is introduced to us at a very young age, usually by our parents. The common phrase "look at me when I'm talking to you," is a prime example of the lessons we are taught surrounding this simple action. Because eye contact as a behavior seems important to people within our society, research regarding its effect on interpersonal communication and relationships have been conducted for many years.

An early study by Tipton and Rymer (1978) investigated the effects of varying levels of counselor eye contact on client-focused and problem-focused counseling styles. They found that the greater the percentage of time the counselor gazed in the direction of the client's eyes the more positively the counselor was evaluated. This may indicate that eye contact may have an impact on the receiver of eye contact emotions toward the other individual. Another example came from work presented by Hornik (1987), who studied the effects of touch and gaze on the compliance of participants. In his study, participants were approached at the mall by either a male or female experimenter and asked to participate in a study. Half of the people were touched and looked at directly in the eye when the researchers asked and the other half were not touched or given eye contact. Percent compliance for the participants who were touched and gazed at was significantly higher than percent compliance for participants who received no touch or gaze (76.4% vs. 54.2%). Participants who were touched and gazed at were also more willing to be re-interviewed at a later time, reported feeling less burdened by being a part of the study, and rated the interviewer as more professional and important-seeming. Hornik interpreted his findings as showing that touch and eye contact matter when trying to get someone to comply with you because, in part, eye contact improves interpersonal communication and positive feelings toward the other person.

In addition to positive emotional valence and compliance with a request, eye contact also seems to have an impact on individuals' helping behavior. In a study by Goldman and Fordyce (1983), eye contact and touch effects were shown to influence pro-social behavior. In their experiment, participants were given eye contact or no eye contact, a touch or no touch, and they were spoken to in either a warm expressive voice or a flat and inexpressive voice. After the interview was over, the confederate "accidentally" dropped some papers. This was done to investigate how willing each group was to help the interviewer recover the dropped items. Overall, participants who were given eye contact, touch, and/or talked to in the warm expressive voice were more willing to help than participants who did not receive any of these behaviors which are considered important pro-social ways of interpersonal communication.

We also were interested in considering the personality differences of participants and the impact this had on their emotions toward receiving eye contact. Some people might be more inclined to feel intimidated than others when they are given eye contact, while others might feel offended when eye contact is not given to them because they take this behavior as a cue that what they are saying is being attended to. Exeline, Ellyson and Long (1975) argued that eye contact could be used by some people to intimidate others and that eye contact can be seen as an aggressive act if used to intimidate. We decided to look at the introverted and extraverted personality trait dimension in our participants and how it possibly related to emotions about eye contact.

The main purpose of this experiment was to determine whether levels of eye contact in an interview setting produced different levels of positive and negative emotions towards the interviewer by participants. We expected that participants who received eye contact would indicate they experienced more positive emotions during an interview than participants who did not receive eye contact. We also evaluated whether persons who indicated higher levels of introversion (e.g., shyness) exhibited this positive appraisal when given eye contact by the interviewer.

Method

Participants

The participants were psychology undergraduate students from Columbus State University. There were a total of 38 participants (31 women and 7 men, ages 18-64 years). Participants were recruited through an online research system (SONA), and received one participation credit for being a part of this study.

Materials

A survey was developed by the team of researchers conducting the experiment which included a series of questions answered using a 5-point Likert scale (see Appendix A, Part I). Six questions on the survey pertained specifically to how the participant felt about the interviewer. Eight questions asked if participants experienced certain specific feelings in the interview, and four questions inquired about how participants felt during the interview in more general ways. In addition to this survey, participants were given a shortened version of the Big Five Inventory personality questionnaire (Pervin & John, 1991). Questions 1, 6, 11, 15, 21, 26, 31, 36 were used to assess whether the participants were introverts or extraverts (see Appendix A, Part II). They were classified as introverted or extraverted dichotomously. Those who scored between 8 to 20 were classified as introverts and those who scored between 21 to 40 were classified as extraverts.

Design and Procedure

The experiment was conducted on campus at Columbus State University. There were two researchers for every participant. One researcher provided the participants with the forms to be completed while the other researcher conducted the interview. Eye contact during the interview was manipulated as a between- subjects factor. In the eye contact condition, the interviewer gave eye contact to the participant during the interview. In the no eye contact condition, the interviewer maintained very minimal to no eye contact with the participant by staring at her clipboard and pretending to be writing notes during the interview. Participants were randomly assigned to either the eye contact group or the no eye contact group.

Each participant was interviewed and surveyed individually within a 20-minute session. Participants first were asked by one researcher to fill out a consent form informing them of the nature of the experiment and that deception could be involved. After participants signed this document, the researcher exited the room and the other researcher proceeded to conduct the interview. During the interview, participants were asked to give a brief synopsis of their favorite childhood memory. They then were asked a few questions pertaining to their memory such as how old they were at the time of their favorite memory, who played a part in this memory, and where it took place if these were not mentioned in the telling of the memory. After the interview was completed, participants then were asked their college GPA, and then they were asked to complete a survey assessing their feelings during the interview and toward the interviewer, and to complete a personality questionnaire.

Once participants finished these measures they were asked to place the finished questionnaires in a box with a slot in it, and were assured that their information would be kept completely anonymous. After this, participants were asked to stay for a debriefing session. During this debriefing session researchers explained that, although they were led to believe that the experiment was about fondest childhood memory and college grade point average (GPA), the study was actually about how eye contact, or the lack thereof, makes people feel. Researchers also explained that this deception was necessary for the experiment to get valid results.

Results

All means are reported in Table 1. Analyses focused on the two categories of eye contact and no eye contact and their influence on positive or negative emotion scores. In order to evaluate the difference between the participants that received eye contact and those that did not, the survey questions were grouped based on whether or not they were asking the participant if the participants experienced a positive emotion (questions 1, 2, 3, 6, 8, 9, 20) or a negative emotion (questions 7, 11, 13, 15, 16, 17, 18) during the interview. An independent-samples t test was conducted to compare the means of the positive and negative emotion categories. Participants who received eye contact rated the interviewer and their experience more positively than those who did not receive the eye contact, $t(36) = 4.38, p < 0.05$; MEC = 30.4 (4.47), MNEC = 22.6 (6.38) (see Figure 1).

However, there was no significant difference between the negative emotion scores for participants who received eye contact and participants who did not receive eye contact, $t(36) = -0.92, p = 0.36$, MEC = 9.5 (5.50), MNEC = 10.9 (3.43).

A 2 X 2 factorial (eye contact X personality) analysis of variance (ANOVA) was conducted to assess whether individuals' self-reported personality on the introversion-extraversion scale effected whether or not they felt positive or negative emotions during the interview. There was no interaction found between the personality dimensions and whether or not the participant received eye contact on positive emotion scores $F(1,36) = 0.047$, $p = 0.83$. There was also no interaction between the personality categories and whether or not the participant received eye contact on negative emotions scores, $F(1,36) = 1.76$, $p = 0.19$. Although not significant, there was a trend indicating that when participants who were classified as introverts received eye contact, they reported more negative emotions than participants who were classified as extraverts (Figure 2).

Discussion

The focus of this study was on whether or not receiving eye contact during an interview setting invoked positive or negative feelings towards the interviewer. Our research findings supported those from previous research (e.g., Tipton & Rymer, 1978), in that we found a significant difference in positive emotion scores of those individuals that received eye contact than those who did not. We also found that participants rated eye contact to be an important part of communication in a conversation, which also supports Wiens et al.'s (1980) findings that eye contact serves as a cue that helps individuals harmonize their conversation with one another. In general, eye contact appears to make people have more positive feelings towards an interviewer (although more research should be done on how personality affects this).

This experiment also focused on the participant's introversion and extraversion personality scores and the influence these had on emotion scores when eye contact was administered or omitted. Our data showed no statistical significant results for individuals with extroverted personalities who were given the eye contact. Data from individuals characterized as introverted showed no statistically significant results; however, a small difference was trending where those who received eye contact seemed to express more negative emotions on average than those who did not. One reason this result did not reach significance may have been due to the small number of participants who were introverts. A power analysis was conducted using G*Power 3 to determine the sample size required for the observed mean negative emotion ratings to be significantly different (Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. 2007). The power analysis was executed keeping Cohen's d effect size constant at 0.56, while striving for power of at least 0.8 given an alpha of 0.05. It was determined that a sample size of 40 participants in each personality classification category would have yielded a statistically significant result.

This would have supported conclusions made by Exeline et al. (1975) that eye contact could be seen as a negative behavior and elicit feelings of intimidation for some people?. We argue that if a person is high on introversion, the act of gazing directly at them for extended periods of time may make them uncomfortable given their shyness.

Based on Exeline and colleague's work, the idea that eye contact can be used as a social control to dominate others is plausible. People with introverted personalities, consequentially, may be more apt to feel intimidated and vulnerable towards somebody that is constantly gazing and given them attention. Alternatively, we argue that if a person is high on extraversion, sustaining eye contact would be viewed as not only acceptable, but desired. Our findings illuminated our understanding that eye contact may not be favored by all people and that some personality aspects could influence an individual's response to it.

Several limitations to our study included a disproportionate amount of female participants than male participants, and low numbers of introverted participants. We were interested in possible gender differences in the constructs investigated. If given the opportunity to conduct a related experiment, in the future, we would like to have a more equal representation of males and females in our sample. Additionally, better recruitment of introverted participants would be desired to verify the trend we saw in the results regarding personality differences relating to the effect of eye contact on participant emotion.

Future improvements to our study would include changing the cover story initially provided to each participant. The two variables they were told we were measuring were favorite childhood memory and college GPA. These variables did not intuitively seem related and their relationship was questioned by most participants. One suggestion was to ask participants to make up a story using a picture provided by the interviewer as a way of evaluating their verbal ability and that the study was going to look at how that ability correlated with academic success measured by GPA.

Even with the limitations discussed, this study revealed valuable results about the purpose of eye contact in interpersonal communication. Eye contact can be an important part in welcoming new relationships and establishing good communication with others. Generally, previous studies and our present study support the idea that eye contact elicits more positive than negative emotions toward a person. As a rule, people should strive to give eye contact to others because many people use this as a social cue that the person is attending to their conversation, people tend to evaluate the eye-contact giver more positively, and are more likely to trust a person who looks them in the eye. We should also be aware that people who are more introverted may feel uncomfortable when they receive eye contact. Professional individuals should be especially attentive that eye contact may not be equally welcomed by all persons. Eye contact is an important communications cue in our culture, however, its effect on the communication process depends on individual differences.

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Appendix A
Eye Contact - Emotion Survey

Part I

The Friends Group Survey

Answer the questions, with one meaning not at all and five meaning
very much.

1. Did you like the interviewer?	1 2 3 4 5
2. How important did you feel during the interview?	1 2 3 4 5
3. How comfortable did you feel during the interview?	1 2 3 4 5
4. How important did you feel your information was to the interviewer?	1 2 3 4 5
5. Did you feel like the interviewer was listening to what you had to say?	1 2 3 4 5
6. How validated did you feel during the interview?	1 2 3 4 5
7. How rude was the interviewer?	1 2 3 4 5
8. How nice was the interviewer?	1 2 3 4 5
9. Did you feel like the interviewer cared about what you were saying?	1 2 3 4 5
11. Did you experience any fear?	1 2 3 4 5
12. Did you experience any happiness?	1 2 3 4 5
13. Did you experience any annoyance?	1 2 3 4 5
14. Did you experience any surprise?	1 2 3 4 5
15. Did you experience any anger?	1 2 3 4 5
16. Did you experience any disgust?	1 2 3 4 5
17. Did you experience any sadness?	1 2 3 4 5
18. Did you experience any shame?	1 2 3 4 5
19. Where you paying attention to what the interview was asking or saying to you?	1 2 3 4 5
20. How important did you feel eye contact was during the interview?	1 2 3 4 5

Part II

Answer the questions, with one meaning not at all and five meaning
very much.

I see myself as someone who...

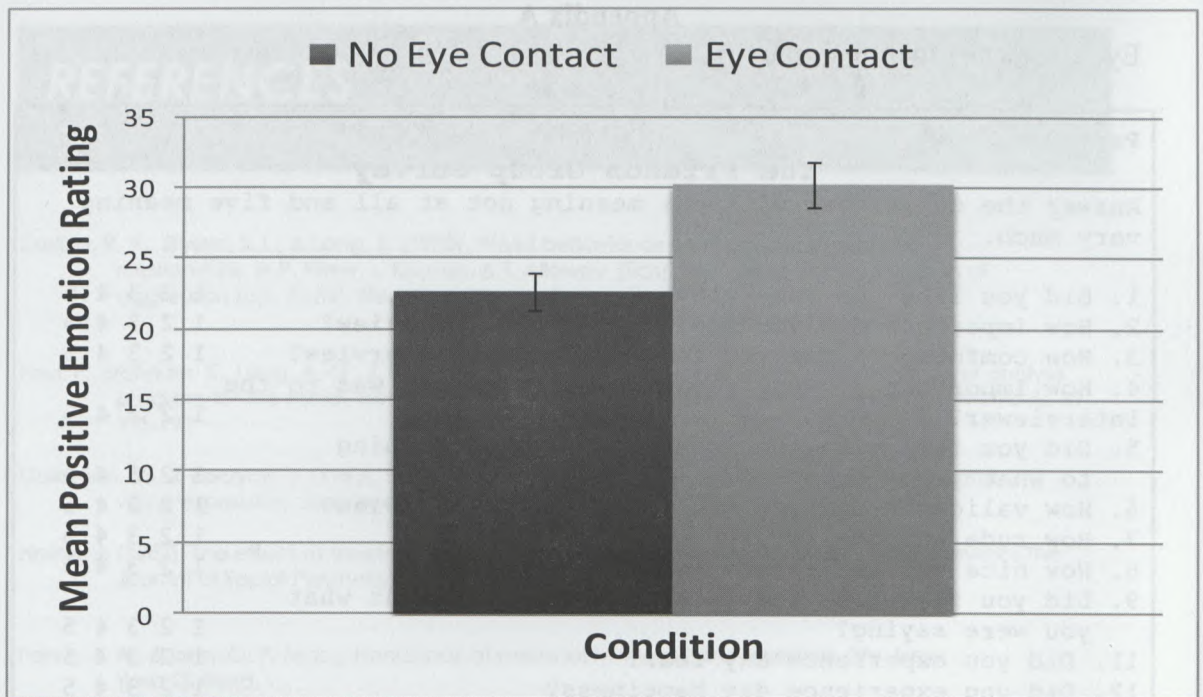|	
1. Is talkative	1 2 3 4 5
2. Is reserved	1 2 3 4 5
3. Is full of energy	1 2 3 4 5
4. Is ingenious, a deep thinker	1 2 3 4 5
5. Tends to be quiet	1 2 3 4 5
6. Has an assertive personality	1 2 3 4 5
7. Is sometimes shy, inhibited	1 2 3 4 5
8. Is outgoing, sociable	1 2 3 4 5

Figure 1. Mean Positive Emotion Rating for participants who received eye contact and participants who did not receive eye contact.
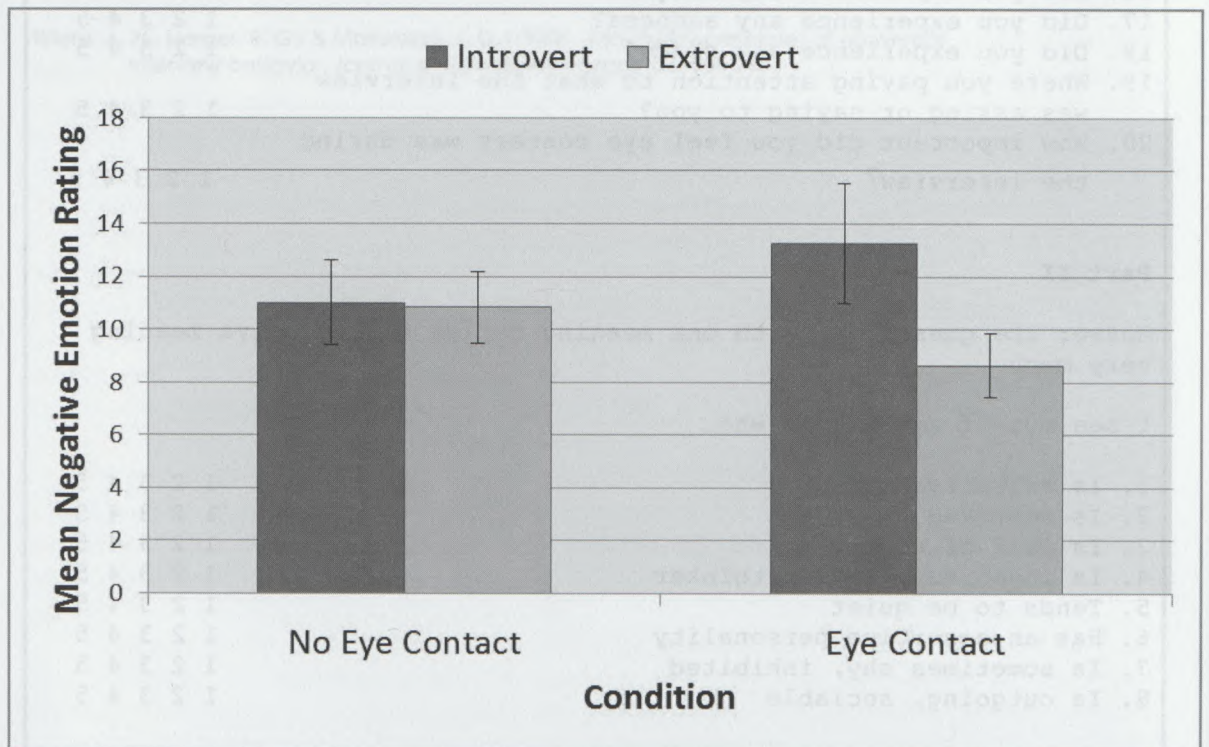

Figure 2. Mean negative emotion ratings for participants in each eye contact condition and their personality classification.

Table 1

Descriptive statistics for all conditions by survey question valence and personality categorization

| Emotion Valence | Eye Contact | | | | No Eye Contact | | | |
| | Extroverted | | Introverted | | Extroverted | | Introverted | |
	n	M (SD)	n	M (SD)	n	M (SD)	n	M (SD)
Positive	14	30.2 (4.96)	4	30.2 (2.98)	11	22.2 (5.15)	8	23.1 (8.13)
Negative	14	8.6 (2.70)	4	13.2 (11.20)	11	10.8 (2.67)	8	11.0 (4.47)

Meme Versus Gene
Heidi Packard, History

ABSTRACT

In sixth century Spain, Archbishop Leander of Seville composed a letter to his younger sister Florentine, wherein he persuades her to remain a virgin and commit to a life of celibacy. The typical life trajectory for a woman of her age and social status would entail marriage and motherhood. Instead, Florentine chose the path laid out by her brother, thus denying some of the most fundamental human desires for sexual intercourse, pair bonding, and child rearing. What could have prompted her to make such a life altering decision? The key to understanding Florentine's choice lies in understanding human biological drives. In his landmark book, The Selfish Gene, evolutionary biologist Richard Dawkins offers an intriguing explanation for human behavior by explaining our biological and genetic origins. He shows that our genes influence much of how we think and behave and that these genes exist and are successfully replicated because they have some survival value for the individual. Dawkins also coined the term meme, to describe the replication of cultural ideas. He proposes that memes function in an analogous manner to genes. By viewing Leander's letter through the lens of Dawkins' meme/gene analogy, it is possible to better understand why Leander and Florentine were both committed to the ideal of virginity in lieu of marriage and procreation. The memes conveyed in Leander's letter offer persuasive reasons for Florentine to remain a virgin; specifically the promise of future eternal rewards, advanced spiritual status, and social benefits. In addition, Leander skillfully uses metaphors with respect to marriage and motherhood as a substitute for any loss that Florentine, as a "sacrificial virgin" may have felt.
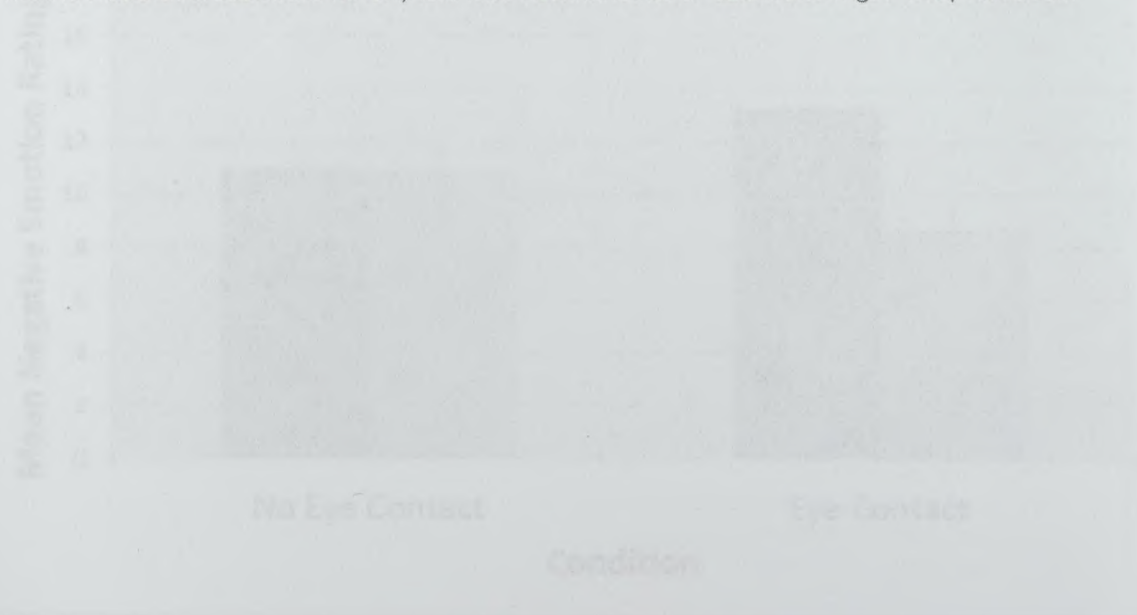
Archbishop Leander of Seville (544 - c. 600 CE) influenced the lives of those around him in various ways. Most famously, perhaps, he persuaded Visigothic King Recared (586-601) and his older brother to abandon their Arian faith and convert to orthodox Christianity. This achievement profoundly strengthened the viability of Visigothic rule by eliminating "... one of the most serious causes of friction between the ruling caste and the subject population".[1] However, Leander's successes were also apparent in his personal life. He successfully educated his younger brothers Fulgentius (c. 556 - c. 619) and Isidore (560-636), both of whom became successful bishops, and guided the trajectory for his sister Florentine's life by persuading her to commit to the ascetic ideal of virginity.

In 579, Leander dedicated his rule, On the Teaching of Nuns, to his sister, wherein he conveyed the many reasons for her to commit to a life of celibacy and provided regulations and guidance regarding the daily activities of cloistered nuns. As a classically educated Christian trained in the art of rhetoric, Leander utilized these skills to effectively persuade Florentine to forsake marriage and procreation for a life of asceticism and virginity. Consequently, at the age of twenty, Florentine (559-?) decided to relinquish the customary future commitments of marriage and motherhood particular to a woman of her age and social status, and chose instead to live in a cloistered environment with other devout females. What could have prompted such a life altering decision? How could a religious idea circumvent some of the most fundamental human desires such as sexual intercourse, pair bonding, and child rearing?

It is highly provocative and tempting to try to explain Florentine's decision by attempting to analyze her psyche. However, Florentine kept no personal records of any kind and Leander's letter is one of the few artifacts containing information about her. Furthermore, as historian Elizabeth Clark notes, a psychoanalytical approach is limited because "Freudian-inspired assumptions of 'normal' psychosexual development and family relations are dubiously applied to the ancients".[2] Modern ideas of socially acceptable behavior cannot be applied to societies where, for instance, thirty-year old men became engaged to ten-year old girls.[3]

The task of trying to understand the motivations behind Florentine's decision is especially challenging because the etiology of human behavior is multifactorial and guided by external forces as well as internally held beliefs. However, scientists in the fields of sociobiology and evolutionary psychology have proposed a method for understanding human behavior that transcends time and cultural space. Ancient and medieval societies might have had different standards of normal behavior in relation to modern societies, yet all humans are composed of biological replicators that dictate much of their behavior. In reductionist terms we can say that living bodies are no more than machines programmed by genes that have survived.

1 Joseph F. O'Callaghan, A History of Medieval Spain (Ithaca: Cornell University Press, 1975), 46.

2 Elizabeth A. Clark, "Theory and Practice in Late Ancient Asceticism: Jerome, Chrysostom, and Augustine," Journal of Feminist Studies in Religion 5, no. 2 (Fall, 1989): 29.

3 Ibid., 29.

[4] In order to seriously consider the human condition and understand the impetus behind human behavior we must first understand the deepest and most primal roots of our own biological history. Without an understanding of biological evolution through natural selection, "... the humanities and social sciences are the limited descriptors of surface phenomena, like astronomy without physics, biology without chemistry, and mathematics without algebra."[5]

In his landmark book, The Selfish Gene, evolutionary biologist Richard Dawkins offers an intriguing explanation for altruistic human behavior by explaining our biological and genetic origins. He shows that our genes dictate much of how we think and behave and that these genes exist and are successfully replicated because they have some enduring value for the individual. Dawkins also coined the term meme to describe the replication of cultural ideas and proposes that memes behave in an analogous manner to genes. By viewing Leander's rule through the lens of Dawkins' meme/gene analogy, it is possible to better understand why Leander and Florentine were both committed to the ideal of virginity in lieu of marriage and procreation. The memes conveyed in Leander's letter offer persuasive reasons for Florentine to remain a virgin; specifically the promise of future eternal rewards, advanced spiritual status, and social benefits. In addition, Leander skillfully uses metaphors with respect to marriage and motherhood as a substitute for any loss that Florentine, as a "sacrificial virgin", may have felt.

Richard Dawkins' book demonstrates how our genes, as the fundamental unit of biological replication, are responsible for many seemingly altruistic behaviors. A gene has no conscience and no sense of moral behavior. A gene's sole purpose is to replicate. Thus, a gene seems to behave in a selfish manner. However, this "selfish" gene's desire to replicate can explain acts of unselfish human behavior. For example, a mother who sacrifices her own life in order to save the life of her child can be explained by gene theory. This "sacrificial" gene is more likely to survive and replicate because the children of this woman will not only have a greater chance of carrying this gene, they will also be more likely to live long enough to pass the gene to their own offspring. Even if the mother meets an early and untimely death, the gene survives in her descendants. Conversely, the mother that does not carry this "sacrificial" gene but rather a "non-sacrificial" gene will be more likely to survive, yet her offspring will not. Her "non-sacrificial" gene will not be able to successfully replicate. Therefore, many mothers (and fathers) have evolved to behave altruistically because it is literally in their DNA.

A meme is defined as a cultural idea that survives and replicates in a manner similar to a gene. Darwin's theory of natural selection applies to ideas just as it applies to species; only the method of transmission and replication is different. "Just as genes propagate themselves in the gene pool by leaping from body to body via sperms or eggs, so memes propagate themselves in the meme pool by leaping from brain to brain via a process which, in the broad sense, can be called imitation". [6] Ideas, art, fashion, language, and music can all be considered memes when they are copied by various people and evolve or mutate as they pass from brain to brain. Memes that are proficient at replication endure and become more prevalent in societies, while memes that are not good at replicating eventually die out. An

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[4] Richard Dawkins, The Selfish Gene, 30th anniversary ed. (1976; repr., Oxford: Oxford University Press, 2009), 98.

[5] Edward O. Wilson, On Human Nature (Cambridge: Harvard University Press, 1978), 2.

[6] Dawkins, 192.

idea that is useful provides a very good motivation to propagate itself. If an idea becomes outdated and useless, then it usually dies out because it serves no purpose and people will not spread it. For instance, religion is a meme or memeplex (a related group of memes) that spreads because it is good at survival. In fact, some religious memes, such as the belief in an afterlife, have been some of the most successful memes in history, to the point that they are nearly universal within religious communities. Parents teach this religious meme to their children, relatives, friends, and neighbors. Thus, a religious meme can spread horizontally through societies via missionary work, or vertically through families via education of offspring, leaping from brain to brain through imitation.

Leander's letter to Florentine is replete with religious memes directing her towards a life of celibacy and asceticism. The meme of celibacy provides a unique scenario wherein the meme is in direct opposition to an individual's genes. Obviously, a gene for celibacy will never be able to successfully replicate itself. Yet, a meme for Christian celibacy has survived for over two thousand years because there is something about it that is appealing to religious people, thus making it successful within religious communities. Therefore, we can begin to understand why Florentine would choose to act in such a way as to deny her own DNA in favor of this religious meme, by examining why this celibacy meme was successful.

First, it is interesting to note that Leander's letter is a perfect example of self-replicating memes. Leander replicated the ideas of other Early Christian writers and produced a new, slightly different copy for his sister's benefit. Leander frequently quotes directly from biblical writings, especially the apostolic writings of Paul.[7] In the first paragraph, he tells Florentine that her inheritance of their father's farm and estate are not of lasting worth, "...for the fashion of this world passes away".[8] Leander relays quotes from the Old Testament as well. He describes to his sister how Christ, as her bridegroom, will bring her rewards in heaven, and then references a Messianic Psalm noting that Christ is "...fairer than the children of men".[9] These verbatim quotes are the obvious source of Leander's ideas and are an example of the direct replication of certain religious memes.

In addition, Leander's letter contains ideas that suggest a direct influence from Early Christian writers who came before him, specifically Augustine of Hippo. Leander does not credit his ideas to Augustine. Yet, as a classically educated Catholic bishop, it is most likely that Leander owned and studied the writings of Augustine.

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7 I have used only two biblical examples, yet there are many in this text including quotes from Jeremiah, II Timothy, Colossians, I John, Genesis, Matthew, Luke, and others.

8 Leander of Seville, Saint Leander, Archbishop of Seville: A Book on the Teaching of Nuns and Homily in Praise of the Church (Lanham, Maryland: Lexington Books, 2009), 62.

9 Ibid., 66. In this same passage Leander also quotes from Song of Songs. Translator, John Martyn notes Leander's request that Florentine should not read the Song of Songs, because it is too salacious, even though Leander quotes from it several times throughout.

One readily apparent form of imitation is the rule itself. Augustine wrote a rule for nuns, over one hundred years earlier.[10] No doubt Leander was influenced by Augustine's desire to write down specific guidelines for cloistered females. Both men provided rules governing the daily habits and lifestyles of these women, including what a nun should wear, how she should behave, when and what she should eat, and what songs she should sing.

It is important to understand how these religious ideas were replicated within the culture of Late Antiquity. Yet the fact that imitation and replication of these ideas occurred does not necessarily explain why they were successful, only that they were successful. In order to understand Florentine's decision to commit to a life of celibacy, we must understand and examine why this particular meme was successful. In other words, what made this idea so appealing that it did not die out?

The promise of eternal reward in the afterlife is a compelling motivator for people of any religion, and it is a promise bestowed upon Florentine if she chooses to remain a virgin. Leander assures his sister that her eternal future is blessed with a heavenly crown as the bride of Christ, and as a nun she will possess primary status in the kingdom of God.[11] However, it is not only her position in the kingdom of God and personal salvation that is assured, but also that of her brother. "You are my safeguard with Christ, you, my darling sister, are my security and my most sacred offering, whereby I am sure to be forgiven for the impurity of my sin".[12] Leander further notes that her decision will also increase their parents' merit in the afterlife.[13] Thus, Florentine's vow of chastity allows for her own personal salvation, acts as a pardon for her brother's sins, and also provides a post-mortal spiritual advantage for her parents.

According to Leander, virginity also provides Florentine with an advanced spiritual status because of her special relationship to Christ. With Christ as her bridegroom, the virgin is a privileged woman, and as such will enjoy the benefits of this eternal relationship.

Virginity claims a special prerogative for itself in Christ, in that a virgin may claim as her bridegroom him before whom angels tremble, whom the heavenly powers serve, whom the virtues obey, to whom things celestial and terrestrial bend their knees.[14]

Because Leander uses words evoking images of a royal and powerful spouse, the psychological appeal of this spiritual marriage is readily apparent. As the daughter of a wealthy Cartagenian official, Florentine would have married a man of equal social standing and wealth. The alternate option, marriage to the King of Kings, Lord of Lords, and master of the universe would surely be an enticing choice.

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10 Augustine of Hippo, *Augustine of Hippo and His Monastic Rule* (Oxford: Clarendon Press, 1987), 110-118.

11 Leander, 84.

12 Ibid., 74.

13 Ibid., 77.

14 Ibid., 66.

Another example of the virgin enjoying an elevated spiritual status is relayed in Leander's notion that a virgin is the ideal to which all other church members hope to become one day. "You already are what all Saints hope to be, what the whole Church expects to become after the resurrection".[15] Not only will her virginity cause her to be saint-like, but she is also, in a sense, already perfect. This idea would certainly appeal to an Early Christian woman indoctrinated from birth with the meme of original sin.[16] In Christian thought, it was the woman (Eve) who brought about the fall because she partook of the fruit and gave it to her husband to partake. As a result, women were generally perceived as

intellectually and physically inferior in Christian society, "disadvantaged by their bodies and by a suspect sexuality".[17] To be promised the ability to overcome such an inferior state would certainly seem appealing.

Early patristic writers believed virginity to be the higher ideal for both men and women. Despite the fact that these orthodox theologians generally perceived women in a negative light, they were committed to the doctrine that God is indiscriminate when it comes to gender. Indeed, "the logic of Christian doctrine required a commitment to sexual equality".[18] As such, virginity provided an opportunity for women to obtain freedom from the female condition, and thus renew "that sweet receptacle of chastity, which the first humans lost in paradise".[19]

In addition to the spiritual sense of worth and personal satisfaction bestowed upon virginal women, social benefits associated with this ideal caused the commitment of virginity to be more enticing. Leander informs Florentine that her decision to remain a virgin will be viewed as a sacrifice for the group. "For by virtue of your decision, and by virtue of its faith, the whole church has won the name of virginity".[20] A woman who sacrificed her own ability to bear children, for the benefit of the whole, would certainly enjoy many accolades from her friends and family.

Joyce Salisbury notes that this concept of the "sacrificial virgin" is deeply connected to societies of the Iberian Peninsula dating back to the Celtic communities in 600 BC. [21] These pre-Christian societies believed that virgins had a direct connection to the fertility of the land. Married women could bear children and thus bring forth fruit to the private sphere of their own family.

15 Ibid., 69.

16 Ibid., 70.

17 Marilynn Dunn, The Emergence of Monasticism: From the Desert Fathers to the Early Middle Ages (Malden, Massachusetts: Blackwell Publishers, 2000), 42.

18 Jo Ann McNamara, "Sexual Equality and the Cult of Virginity in Early Christian Thought," Feminist Studies 3, no. 3/4 (Spring-Summer, 1976): 2.

19 Leander,70.

20 Ibid.,71.

21 Joyce E. Salisbury, "Fruitful in Singleness," Journal of Medieval History 8, no. 2 (1982): 98.

Conversely, a virgin renounced her ability to privately propagate and by virtue of this sacrificial act, brought fertility to the entire community. Hagiographers adopted this popular sentiment and began to attribute virginity to the female saints they eulogized, regardless of their actual practices. Most likely, Florentine would have been familiar with this meme and would have appreciated the exalted social status bestowed upon virgins.

Although Florentine's community may have perceived her commitment to virginity as an act of self-denial, the realistic consequences of her vow did not necessarily entail a complete renunciation of her wealthy background. Although the earliest Christian ascetics often lived unrefined and solitary lives, the later Roman ascetics began to practice a form of genteel asceticism. These noble men and women often retired to their country estates where they practiced their renunciation in polite retreat, exchanging the letters that were the hallmark of cultivated society, making simple meals palatable to their senatorial tastes, writing verse, worrying about the fate of vintage wines harvested from their estates abroad. Their manner of life as ascetics differed not totally from that of their secular days.[22]

Florentine would have enjoyed a similar secular lifestyle with her parents in North Africa and perhaps would have expected a similar manner of genteel asceticism in her own life. Leander seems to allow for this, to a certain extent. For example, he specifically writes that a wealthy nun is to be "treated more pleasantly in a convent" and deserving of a more elegant habit than those of her poorer sisters.[23]

Even though Florentine's manner of living would change somewhat within the cloister despite her superior secular status, she must have considered the benefits of virginity to outweigh any sense of loss or personal sacrifice. Leander helps mitigate this potential loss by skillfully including specific images related to spiritual marriage and spiritual motherhood and shows these conditions to be superior to their earthly counterparts.

Leander describes the trials and tribulations of human marriage to Florentine in such a way that virginity would seem more enticing. For Leander, marriage is self-imposed servitude and a yoke of bondage.[24] The husband rules over his wife and she will bear children in sorrow.[25] Conversely, the woman who chooses spiritual marriage will enjoy a loving relationship with Christ as her husband. "His left hand, in which there is honor and glory, is under your head, and his right hand, in which there is a long span of life, shall embrace you".[26]

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22 Elizabeth Clark. "Ascetic Renunciation and Feminine Advancement: A Paradox of Late Ancient Christianity," in Ascetic Piety and Women's Faith: Essays on Late Ancient Christianity (New York: Edwin Mellen Press, 1986), 181.

23 Leander, 108.

24 Ibid., 68.

25 Ibid., 80.

26 Ibid., 74.

Such intimate language, freely adapted from the love scene in Song of Songs, suggests a loving and intimate relationship surpassing any possible mortal association. Leander further notes that marriage leads to sexual intercourse, which corrupts the body, then leading further to pregnancy, pain, and the possibility of death for both mother and child.[27] Only through spiritual marriage to Christ can Florentine escape this scenario, experience a heavenly conception, and enjoy the offspring of virginity. He promises that she will have "as many children as you shall have virtues".[28] Thus, Leander's letter shows Florentine that her decision to remain a virgin will not only keep her safe from the servile nature of marriage and the dangers of pregnancy and childbirth, but also promises her the corresponding celestial options.

Very often, memes and genes compliment each other and facilitate their respective replications. However, Leander's rule for nuns offers a distinct example of a religious meme in direct conflict with a selfish gene. As the fundamental unit of replication, a gene's primary purpose is to survive and replicate through sexual intercourse. A meme's primary purpose is to survive and replicate by travelling through societies via imitation. An interesting dynamic occurs when a religious meme compels an individual to behave in such a way so as to deny some of their most basic human desires.

Florentine's decision to remain a virgin and forfeit the possibility of marriage and motherhood, is more easily understood when viewing this choice through the lens of Richard Dawkin's meme/gene analogy. Leander's rule offers compelling rationalizations for Florentine to choose the life of a cloistered nun. By promising future eternal rewards, advanced spiritual status and social benefits, as well as a celestial compensation for marriage and motherhood, Leander's religious ideas successfully triumphed over Florentine's most essential biological nature.

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27 Ibid., 78.

28 Ibid., 82. Leander cites seven offspring; modesty, patience, sobriety, temperance, charity, humility, and chastity.

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Hope for Religious Reconciliation in Shakespeare's *The Comedy of Errors*

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ABSTRACT

Throughout the reign of Queen Elizabeth I, England suffered from perpetual religious dissension and uncertainty. Under the rule of Protestant Elizabeth, secrecy, confusion, suspicion, and possible punishment haunted those who attempted to practice Catholicism. Consequently, England was a divided family forced to wander aimlessly and search for compassion and trust from those who had abandoned them. Both Catholics and Protestants yearned for a time in which they could live together in a harmonious, accepting, and prosperous familial relationship. Shakespeare was greatly familiar with the strain placed on the relationship between Catholics and Protestants during his tumultuous age, and craftily placed religious references and symbols in his works. My paper discusses how Shakespeare's The Comedy of Errors captures the desire of Protestants and Catholics to achieve spiritual renewal and political reconciliation in their country. I argue that the play's divided family, which travels on foreign soil and attempts to recover those members who have strayed, represents the divided religious sects of Elizabethan England. Through his play, Shakespeare offers a resolution to the religious turmoil of his time with his implementation of the moralistic teachings of the Elizabethan homilies, authorized sermons used by the Church of England during Elizabeth's reign. Shakespeare demonstrates that if the Protestants of Elizabethan England were to adhere to these homilies and be as compassionate and understanding as   the play's Catholic characters, England would obtain the harmonious and spiritual unity desired by both Catholics and Protestants.

England in the Elizabethan age was a divided family, a family beset with religious dissension and uncertainty. There was deep longing among Catholics and some Protestants to achieve spiritual renewal and political reconciliation in their country. The plot of Shakespeare's light comedy The Comedy of Errors addresses this yearning through the image of a divided family, a family with hopeful members who wander in a foreign world and attempt to recover and restore their separated unit. The play involves identical twins Antipholus of Ephesus and Antipholus of Syracuse and their identical twin servants Dromio of Ephesus and Dromio of Syracuse. These characters and the Antipholus twins' father Egeon were unintentionally separated many years before in a shipwreck. Egeon, who has resided in Syracuse, searches for his son in the city of Ephesus which is in a trade war with his own city. He is threatened with execution if he cannot obtain the necessary funds to free him. During his imprisonment, the Syracusan twins commence to encounter the friends and family members of the Ephesan twins, and a series of calamities, such as accusations of infidelity and madness, occur due to mistaken identity. Shakespeare's fellow Elizabethans would have seen Ephesus as an ancient, alien realm permeated with practices such as witchcraft, sorcery, exorcism, and early Christianity and as a contemporary but equally distant world dominated by Muslim Turks. However, in The Comedy of Errors, Shakespeare transforms this city into one that, at the play's conclusion, seems to be a much more pleasant, morally upright destination for travelers instead of one that constantly plagues its visitors with unwelcome events and situations. The accusations that strangers to Ephesus vindictively hurl at it are due only to these individuals' own misunderstandings, impatience, and the ever-present, bewildering idea of mistaken identity. The allegations of outsiders against the city are therefore found to be groundless and false. The turmoil suffered in Ephesus represents both the religious turmoil of England at the time of the play's composition and a nostalgic longing for an older era, an era of the old religion, Catholicism.

Through The Comedy of Errors, Shakespeare offers a peaceable resolution to the religious conflict that overwhelmed England during the Elizabethan age. Within the play, Shakespeare uses the Elizabethan Homilies and sympathetic Catholic characters who adhere to these homilies to effectively reunite England through their dissolution of the Protestant/Catholic dispute. Shakespeare implements the moralistic teachings of the Elizabethan homilies, which were conspicuously Protestant sermons, to demonstrate that if both Catholics and Protestants adhere to the homilies Against Strife and Contention, On the State of Matrimony, Against Whoredom and Adultery, and On Christian Love and Charity, it is possible to obtain the harmonious and spiritual unity that so many individuals longed for in Protestant England. It is only when the lessons of these homilies appear to be violated that trouble ensues for the characters. However, due to obedience of the play's Catholic characters to the homilies, the play's resolution is a cheerful one, one that restores the initially divided family and the order of Ephesus. All the pieces of the rather complicated puzzle are connected due to the wisdom of kindly and distinctly Catholic figures, the Abbess and the Duke. Because the problems the characters endure in the play are resolved by gentle, sincere, Catholic figures who follow the homilies' teachings, Shakespeare also demonstrates that peace and harmony would be restored if his country accepted Catholicism and halted the persecution of those who practiced it. If the Protestants adhered to the admirable teachings of the Homilies as did the Catholics, England would then be whole again.

Although the devotion of the play's Catholic characters to the homilies is a significant one, [s]cholars who have explored Shakespeare's The Comedy of Errors have for the most part remained silent about the connection between the conflict that troubled Protestants and Catholics of Shakespeare's time and The Elizabethan Homilies of that same era. For instance, Richard Dutton, in his article "The Comedy of Errors and The Calumny of Apelles: An Exercise in Source Study," mentions that the Syracuse/Ephesus divide represents the divide between Christians and Turks and/or Catholics and Protestants. In relation to the play's locale and the Catholic/Protestant dispute, Clare Asquith argues that the characters and places represent different religious beliefs or older versions of contemporary beliefs of the Elizabethan era. These are valid arguments, but I expand on them here in my explanation of how Shakespeare resolved this conflict with the use of principles outlined in the Elizabethan Homilies. In relation to Shakespeare's implementation of the homilies and their effect on the play's characters, Thomas P. Hennings, in his article "The Anglican Doctrine of the Affectionate Marriage in The Comedy of Errors," argues that at the play's end there is a "just society founded on the institution of family and marriage" (Hennings 94). The society can only be just if one follows the rules outlined in the Elizabethan homily On the State of Matrimony. I expand this argument and make it more specific. When I apply the principles of the homilies to the different characters in the play, I show how these principles help resolve the conflict between the Protestants and Catholics of Shakespeare's day. In connection with my argument that the play deals with religion in Elizabethan England, Richard McCoy, E.M.W. Tillyard, and Charles Whitworth all mention religious aspects of the play, but they do not argue that Protestant principles of the time aid in the play's joyful conclusion, as I argue. Overall, I argue that the Catholic characters' successful adherence to the Elizabethan homilies paves the way for a brighter future for Ephesus, or Elizabethan England, and results in the joyful, harmonious reunion of the two formerly feuding families or religions.

One example of how Shakespeare uses The Comedy of Errors to reflect the turmoil Elizabethan England suffered can be found in the play's locale and in this locale's abuse of foreigners. The feuding cities of Syracuse and Ephesus are meant to represent the feuding Catholics and Protestants of Elizabethan England. In his discussion of the models for Ephesus and Syracuse, Richard Dutton states, "Ephesus is both the modern town under the Turkish yoke, and the town traditionally associated with the Virgin Mary, so central to Roman Christianity. So the Syracuse/Ephesus divide is not only that between Christian and Turk; it is also that between Protestant and Catholic" (Dutton 26). He also notes that one of the play's most sympathetic characters, Egeon, is subtly associated with the Jesuits in England. The death sentence that hangs over this character throughout the majority of the play is reminiscent of the execution of the seminary priest William Hartley. The Duke's reference to Egeon as "Merchant of Syracusa" (1.1.3) is comparable to the English Jesuits who addressed each other as "merchant" (Dutton 26). Consequently, Egeon's death sentence is a symbol of the maltreatment of Catholics by Protestants and religious slander in general. Egeon, like his son Antipholus of Syracuse, is a drifting stranger in a foreign land, a "dreamy, melancholy, and religious figure" who represents "the spirituality missing from England since the Reformation" (Asquith 56). Clare Asquith's comment that Antipholus of Syracuse takes on the comportment of an underground Catholic missionary is applicable to Egeon as well. He, like the Catholics in Protestant England, must be wary of strangers.

Nevertheless, Egeon is caught by Ephesian authorities and unjustly sentenced to a mortal punishment. Asquith goes further to say that one of the reasons Ephesus resembles Protestant London, in addition to its puzzling and hostile behavior toward foreigners and its bustling, noisy atmosphere, was its preoccupation with commerce as opposed to religion, which ruled during Catholic London. This is blatant in the Ephesian law which demands that Egeon pay the Duke money in order to be granted his life. Therefore in Ephesus, Egeon's life is the equivalent of 1000 marks. Because Ephesus has cruelly reduced its "enemy" to a commodity, it has neglected to follow the teachings of Against Strife. This uncaring act of Ephesus is thus a symbol of Protestant England's ill-treatment of Catholics and its emphasis on commerce rather than religion.

The ominous event at the opening of the play exemplifies the consequences that could occur if an Elizabethan chose to disobey or simply ignore the teachings of The Elizabethan Homily Against Strife and Contention. The first scene of the play, which is shrouded with gloom, seems out of place in a play deemed a comedy. Innocent Egeon is condemned to death due to the bitter dispute between the Aegean port city of Ephesus and the Mediterranean port city of Syracuse, or between Protestant and Catholic England. The duke eloquently explains to Egeon that:

> The enmity and discord which of late
> Sprung from the rancorous outrage of your Duke
> To merchants, our well-dealing countrymen,
> Who, wanting guilders to redeem their lives,
> Have sealed his rigorous statutes with their bloods,
> Excludes all pity from our threat'ning looks.
> For since the mortal and intestine jars
> Twixt thy seditious countrymen and us,
> It hath in solemn synods have decreed,
> Both by the Syracusians and ourselves,
> To admit no traffic to our adverse towns.
> Nay more: if any born at Ephesus
> Be seen at Syracusian marts and fairs;
> ...he dies,...
>
> (1.1.5-17, 19)

A simple lack of funds will lead to the execution of an innocent individual who is in an unsuccessful quest to reunite with his beloved family members. This incredibly harsh but apparently irrevocable law decreed by Ephesus flouts the teachings in the Elizabethan Homily Against Strife and Contention. Although this homily is mainly concerned with the rivalry between individuals, Shakespeare seems to implement it as a warning against enmity between entire cities or, in the case of England, religious sects. The cities and their competing punishments would have been seen as detestable in the eyes of the Protestants who gave this sermon. Against Strife discusses the great difficulties that ensue due to excessive antagonism.

The homily states that this persistent antagonism leaves the potential unity that God requires of Christians neglected and broken. Thus, the homily continues with a series of questions that relate to this needless competition: "O body mysticall of Christ, where is that holy and happy vnitie, out of the which whosoeuer is, he is not in Christ? If one member be pulled from another, where is the body? If the bodie be drawn from the head, where is the life of the bodie? Wee cannot be ioyned to Christ our head, except we be glued with concord and charitie one to another" (1.12.1-32-37). The two cities have neglected to follow this essential principle of the homily. Due to the strife and contention among the two cities, harmony has been brutally distorted amongst Christians in general, not just the residents of one city or of just one religion. This could lead to earthly consequences as well as consequences in the afterlife. This concept of unity not only relates to the unnecessary brawling between Ephesus and Syracuse but also alludes to the broken unity between Protestants and Catholics.

The acts of the cities of Ephesus and Syracuse are those of revenge, "[a]nd in so going about to revenge euill, wee shew our seules to bee euil, and while we will punish and reuenge another mans' follie, we double and augment our owne follie" (1.12.2-187-189). Both cities seek vengeance for each other's disreputable acts and therefore, according to the Elizabethan homily, increase the malevolence of their own mistakes. As Asquith states in her discussion of contemporary, Catholic-sympathizing plays, Protestants "who, from a mixture of motives—partly envy, partly revenge for their own suffering during the previous reign— persecute[d] the passive, but more appealing and beautiful old religion."(Asquith 53). Thus, this represents the feuding cities eventual resort to violence to quench their thirst for revenge. The "intestine jars", or conflicts, of the Duke's speech do not resolve the issue between the cities, or religions, but merely add to it in an unjust, corrupt way in the form of execution.

The feuding cities subvert the teachings of the Elizabethan Homily Against Strife and Contention at the play's opening and therefore cause more trouble than ever before. However, even in the morbid beginning there is a Christian-like aura of sympathy in the character of the Duke of Ephesus. He benevolently states that if it were in his power his "soul should sue as advocate for [Egeon]" (1.145), but as it can't he is only able to allot Egeon one day to accumulate the necessary funds. Although Egeon is a resident of Syracuse, the Duke is willing to trust him in a Christian manner. He regards him as another human being rather than simply as an enemy whom he should consequently despise, punish, and abandon. Since Duke Solinus probably represents Selimus II, Sultan of Turkey, (Dutton 25) and therefore the "foreigner" that Protestant England felt animosity toward, he is also representative of a prominent Catholic figure, an apparently kind-hearted, respectful, and sympathetic individual who cares not only for Catholics but Protestants as well. Consequently, the foreigners in the play are not as overbearing nor as unfair as they may seem. Shakespeare suggests that perhaps if the Protestants were more like the tolerant Duke of Solinus, an amicable, compassionate relationship between the two religions could be achieved.

Another homily Shakespeare employs in the play to help resolve the religious feud is the homily On the State of Matrimony. This homily relates significantly to the plays' attempt to demonstrate that in order for England to be peaceful and organized again, Protestants and Catholics must harmoniously unite in a blissful marriage.

Thomas P. Hennings argues that the play's "tensions [...] resolve themselves in the completion of the comic movement toward a just society founded on the institution of marriage and family" (94). Egeon's comment at the play's beginning that his family was carelessly split in an "unjust divorce" (1.1.104) also relates to what Catholics felt was an unmerited, religious separation from their country. Significantly, the house in which Antipholus of Syracuse, Adriana, and Luciana reside has a revealing sign hanging over it, that of the Phoenix, which would have brought to Elizabethan minds an image of miraculous rebirth or one of an old existence. The Phoenix represents both the restoration of English Catholics and the deterioration of the old Catholic-dominated England, just as Luciana represents the tolerant, benignly resilient Catholicism of Protestant England, and the "scorned Adriana [] represent[s] old Catholicism, whose slackness drove the country into the arms of the Reformation" (Asquith 59). Consequently, at the play's beginning the Phoenix presides over a rather disconsolate marriage.

The marriage of Antipholus of Ephesus and Adriana reflects the divided religious sects of Elizabethan England. Adriana's grievances about her indifferent husband reflect Egeon's desire for "conjugal love" (Hennings 96) amid the violence and disorder of the religious feud. Adriana's need for an "undividable, incorporate" (2.2. 115) relationship is echoed in the homily's teaching that a man's wife is his "body and made one flesh with [him]" (II:18.1-359). These musings, Hennings states, are not mere words of female vanity but are entirely orthodox. Adriana relates to Antipholus of Syracuse, the wanderer in a foreign land, in that he too searches for love and the restoration of his family (Asquith 60). Consequently, if a husband and wife are "one concord of heart and mind" (II:18.1-403) their state of life will be admirable and contented. Adriana's belief that her husband has isolated himself from her would be, according to the homily, damaging to her marriage. Protestant England, therefore, is related to Antipholus of Ephesus in that it is also seemingly unsympathetic to its marriage partner, namely its brethren in England, Catholics. Because the Protestants have distanced themselves from the Catholics, because they are not one flesh with them, their relationship is not harmonious nor is it fulfilling or productive. If Protestant England is to be obedient to the teachings of its sermons, as the subtly Catholic characters in the play are, it too must respect English Catholics, strive to be one with them, to reunite with them in body and soul, heart and mind.

Antipholus of Ephesus' and Adriana's relationship throughout the play mirrors the relationship between Elizabethan Protestants and Catholics. When Antipholus of Ephesus is locked out of his own home and is humiliated due to what he thinks is his wife's deviation from the homily, her "abuse [of] the gentleness and humanity of her husband" (II:18:1-141), Antipholus of Ephesus resorts to threats of violence, and claims in his rage that he will "...with these nails [] pluck out those false eyes, / That would behold this shameful sport" (4.4.99-100). His threat of future ferocity against Adriana reflects the persecution and harsh punishments inflicted upon Catholics during Shakespeare's era. The Protestants do not adhere to their own sermon, which states that a husband should amend his wife's unruliness with "softnesse and gentleness" (II:18.1-366) rather than with beatings which would increase his wife's wickedness. Protestants, therefore, unlike the Catholic Abbess at the play's conclusion, do not practice the rules they supposedly cherish and upon which they place great importance. Consequently, the Protestants do not uphold crucial tenets in their relationships with their marriage partners. Their failure in this relationship could consequently lead to more violence, disorder, and malice.

The effect a straying marriage partner can have on his or her spouse is highlighted in the Homily Against Whoredom and Adultery, which states that adultery "corrupt[s] both the body and soule of man" and when he does this he "sinneth against his own body" (I.11.2-167) and therefore corrupts his wife's body as well. When Adriana believes her husband to be keeping company with another woman she claims, "I am possessed with an adulterate blot; / My blood is mingled with the crime of lust. / For if we two be one, and thou play false, / I do digest the poison of thy flesh" (2.2.140-44). She believes that her husband's unfaithfulness is the cause of her withering beauty and her unfortunate state. This relates to the state of England at the play's composition. The Catholics believed that the Protestants were neither faithful to them nor helpful in the preservation of the beautiful countenance that once belonged to the Old Faith. Due to the Protestants' neglect of their relationship with the Catholics, they have caused the Catholics to deteriorate and lose their glory. However, in accordance with the homilies, the Protestant faith would also lose its beauty because it has strayed from its other half. The beauty of both Catholics and Protestants can only be restored if the two religions would respect one another and begin a strong, caring relationship.

The conclusion of the play brings together both the Catholic and Protestant characters in an incredible reunion and a joyous rebirth, both of which are made possible by the play's two Catholic characters, characters who obey the homilies' teachings. In relation to the play's conclusion, Richard McCoy makes the convincing remark that the "seemingly miraculous reunion and rebirth in The Comedy of Errors, whose climax delivers 'After so long grief, such nativity!' (5.1.407 [...] sustain[s] a sense of [...] communion" (McCoy 83). The beginning and middle of The Comedy of Errors are showered with images of doom, anger, confusion, and most importantly, a realm divided because its inhabitants have or appeared to have digressed from the homilies which emphasize kindness to and forgiveness of other people. However, the play's end is sprinkled with hope, rejoicing, and stability due to the subtly Catholic Duke's and the blatantly Catholic Abbess's devotion to the Elizabethan Homily on Christian Love and Charity. With their help, a miraculous turn of events occurs. A harsh punishment, a "passèd sentence [that] may not be recalled" (1.1.147), is charitably lifted by the Duke for now, as the Duke states, "it [the money] shall not need" (5.1.392). The Duke's act of kindness at the play's end relates to the Catholic characters' devotion to the Elizabethan homilies and their respect for "foreigners," or Protestants.

At the play's conclusion, the Catholic Duke embodies the tenets of Christian love and charity outlined in the homily. His refusal of the money offered to him by Antipholus of Ephesus emphasizes his understanding, sympathetic Christian demeanor. The foreigner or the Catholic figure in the play has the last say in the fate of the originally divided family, and because of his kindness and tolerance, it can be assumed that this fate is a happy, harmonious, and whole one. According to the Homily on Christian Love and Charity, charity is "to loue euery man, good and euill, friend and foe, and whatsoeuer cause be giuen to the contrary, yet neuertheless to beare good will and heart vnto euery man, to vse our selues well vnto them, aswell in wordes and countenances, as in all our outward actes and deedes" (1.6.1-33-7). The Duke's love for his fellow man, although this man is a stranger on his soil and therefore is claimed an enemy in the strict law of Ephesus, is an essential factor in the play's cheerful ending.

The Duke's adherence to the Christian code of the homily in his forgiveness of an enemy has triumphed over the unforgiving nature of the Ephesian law. It is clear that he has followed another one of the tenets that instruct Christians to be charitable: a "gouernour [...] should louingly correct them which bee offendours" (1.6.2-192). Rather than subject Egeon to cruelty, the Duke kindly allows him to go free, which is a Christian act to both Protestants and Catholics. The Duke's action could thus serve as a cornerstone in the formation of a more lenient, compassionate structure of the city of Ephesus, or England. The kindness and forgiveness of a Catholic figure, therefore, has changed lives for the better and paved the way for a better future for all.

The homilies' emphasis on Christian love and charity and the harmony that could be brought about if Protestants and Catholics were willing to love and help one another surfaces at the play's end when Antipholus of Ephesus seeks and finds refuge in an abbey. The abbey acts as a symbol of optimism, a symbol that England would eventually be whole again. It is obvious that Abbess Emilia to whom Antipholus of Syracuse appeals "beareth a good heart and minde, and vseth well [her] tongue and deeds vnto every man, friend and foe" (1.6.1-110). The Abbess, who is a blatantly Catholic figure, is a major player in the liberation of Ephesus and its inhabitants. She is a figure whose chief delight and joy, as the homily instructs, is focused on God and his honor (1.6.1-25) and whose life is given to his service. As E.M.W. Tillyard notes, the Abbess's entrance in the play would have been a surprising one, and the readers can picture her as an austere and majestic authority figure, one who is "tall and commanding, and conspicuous in her black habit among the excited particoloured folk that throng the stage" (Tillyard 180). Catholic Emilia is most noticeably the outsider but she is a generous, kindly outsider who possesses an aura of power and authority over the other characters.

At the play's conclusion, Abbess Emilia adheres to the homilies, and is thus allowed to essentially save the day for Ephesus, or England, and its inhabitants. Emilia devotes her life to Christ and forsakes all other things, thus she is rewarded with the honor of helping to save a life and two marriages. The fact that the "life-saving regression to the primary unit" (Dutton 27) is guided by the Abbess, who would have been comparable to the Virgin Mary in Elizabethan England, suggests that Catholicism is the key to redemption for both Catholics and Protestants. Shakespeare also praises Catholicism as the "Old Faith, the faith of an undivided Christendom" (Dutton 27) in which individuals did not inflict harsh punishments on or berate those who had different religious beliefs from them or who resided in foreign locales. The Abbess not only reunites her own family but she also reunites the body and soul of England itself. The problems undergone in Ephesus, or England, are resolved "within the firm, universal framework of Catholic Christendom" (Asquith 56). Because Abbess Emilia offers the protection of the Old Faith to Antipholus of Syracuse, Shakespeare indicates that though this faith is endangered by the Protestant Reformation, it is not entirely muted: "He took this place for sanctuary, / And it shall privilege him from your hands" (5.1.95-96). She assures those who surround her that she will use medicinal and spiritual treatments in order to gently heal Syracuse: "wholesome syrups, drugs, and holy prayers," and, in relation to the homily, she states that these treatments are "a charitable duty of my order" (5. 1. 105, 108).

She has no supernatural powers with which she can exorcise devils nor does she believe in "cures" for madness such as binding or locking one in a dark room. Rather, she is interested in healing Syracuse in a loving, benevolent manner. She is a depiction of what England lost during the Reformation, such as practical knowledge, which is also represented in her use of natural remedies and in her advice to Adriana on how to be a good wife, advice in which skills representative of the Old Catholic church are emphasized.

With its focus on and praise of the Catholic figures who obey the homilies, the conclusion of the play ushers in a return to the England of old, the England dominated by Catholicism. Thus, the generous, Catholic Abbess, is able to joyously reveal that she is the long-lost wife of Egeon and the mother of the Antipholus twins. Significantly, as McCoy points out, the Abbess's lengthy tribulation of having her family divided is given the "Christological length of 'thirty-three years' and reconceived as a 'travail' (5.1.402) or labor that results in the delivery of her sons and the reunion of her family" (McCoy 90). In relation to Dromio's comment that time has gone back an hour, Charles Whitworth aptly argues that time has now gone back decades to the period in which Emilia's family was undivided. It is therefore appropriate that the Abbess should describe this moment of rebirth, reunion, and reconciliation. At the play's end, the celebration of the Christ's birth, the "nativity" (5.1.406) relates to this and possibly the overall work of God in the joyful resolution of the play. The positive characterization of the Abbess as a "virtuous and a reverend lady" (5.1.135) does not bear any resemblance to the Protestant propaganda at the time. The Abbess is rather a respectable woman, though Catholic, who advocates that her city once again be a land of decency, loving discipline, and harmony. At the play's conclusion, the fact that the Dromio twins walk together hand in hand instead of one preceding the other, demonstrates that neither religion is superior to the other and that there can a reconciliation reached in which both religions will benefit and prosper. Due in part to the Abbess's loving disposition and embodiment of how all individuals should treat each other, England has been reborn and returned to its original state, one that is honorable and sacred.

Although Shakespeare's The Comedy of Errors is set in pagan antiquity, overtones of the unrest between the Protestants and Catholics who resided in Elizabethan England are present. The play's relation to the Elizabethan homilies emphasizes how important it was for Shakespeare's fellow Elizabethans to maintain harmonious relationships with and respect those individuals who were foreign or had different religious beliefs. When individuals fail or appear to fail to acknowledge these teachings, as in the fashion of the characters in The Comedy of Errors, problems curse them and disorder occurs in their surroundings. At the play's opening, obedience is not to the Christian teachings described in the homilies, but rather to an extremely harsh, apparently irrevocable law designed to punish enemies rather than aid them. The harsh law of Ephesus, or Protestant England, has caused mortality, confusion, and animosity to hover ominously over the entire play and its characters. Due in part to noncompliance with the principles of the Elizabethan Homily Against Strife and Contention, Homily on the State of Matrimony, and Against Whoredom and Adultery, Ephesus, or England, has become a country of mayhem and unkindness. It is not until the play's ending that its characters are enlightened with the knowledge that Ephesus can be a place of reconciliation, hope, and Christian love.

The rebirth and reconciliation of Ephesus is made possible by the Christian-like Duke's and the kindly Catholic Abbess's dedication to the Homily on Christian Love and Charity. Because a noble Catholic figure is greatly responsible for the play's resolution of rejoicing and celebration, the play also casts aside the stereotypes of Catholics in England and allows these individuals to pave a brighter future for all who reside there. The principles adhered to by the Abbess and the Duke are outlined in a Protestant sermon, which demonstrates that if Catholics are obedient, caring individuals adhering to Protestant beliefs, then Protestants can do likewise.. If Protestants would allow reconciliation to take place between Catholics and themselves, England would resemble the Ephesus of the play's conclusion, a joyful, harmonious country in which everyone works together to build a stronger, more Christian-like land. After numerous disagreeable years, renewed lives and Christian love and virtues could reign supreme in a much merrier, more charitable England.

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